EIGHTY-FIRST YEAR

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Panic!

By James H. Collins

GIVEN a disaster that would suddenly start the skyscraper population of downtown New York hurrying into the streets in a blind rush like a theatre panic—what would happen? What steps could be taken to safeguard life and property?

The nearest answer thus far found to that question came on the afternoon of November 7, 1918. It was the day of the "false armistice." During the lunch hour a premature report that peace terms had been signed sent New York into the wildest carnival it has ever known. People rushed into the streets, abandoning work. The shops were quickly stripped of every whistle, horn, bell, rattle, tin pan or anything else that would make noise. By some common impulse, thousands already in the city started for the downtown skyscraper section, and many more thousands outside hurried in the same direction, in anticipation that there would be found the vortex of excitement.

That day, Chief John Kenlon, of the New York Fire Department, landed at the Battery an hour after the excitement began, coming from an inspection trip to Staten Island. Responsible for the safety of the city, he immediately viewed the merry making from that standpoint.

"And had New Yorkers been determined to destroy their city that day," he says, "they were taking the most effective means of doing so."

The first thing people did to express their joy over the ending of the long torture of war, was to throw into the streets tons upon tons of fluttering paper—ticker tape, torn-up telephone books and newspapers, dead carbon copies and records, anything and everything that would swell the snowstorm of inflammable material falling upon the joy-crazed multitudes below. From uptown, motor cars came until they were packed solidly along the main streets, absolutely blocked so far as their own movements were concerned, and making the streets impassable for fire apparatus. Tons upon tons of paper littering the streets, and thousands of gallons of gasoline a few inches above! And dense masses of human beings milling over the inferno that might be started any minute by a carelessly tossed match or cigarette butt, or the catching fire of an automobile!

Yet not a single fire alarm was turned in by lower Manhattan that day!

"How do you account for it, Chief?" I asked. "Fires start every day in downtown New York from a dozen different causes apart from that unusual hazard—weren't those other causes operating that day?"

"I can only account for it as the intervention of an all-wise Providence—for six or seven hours that afternoon, the city was literally in the hands of God. Or mathematically, it was the thing that happens once in 10,000 times. But there was one other significant thing—a single ray of sunshine. The people were too excited to smoke! It is a fact that when people are excited, they rarely smoke. They are too busy, too distracted. And on that occasion, you might say, nobody could keep his mouth closed long enough to smoke. We sent firemen to hydrants with hose, and orders to stay there, as the only substitute for apparatus, but had the paper caught fire, the packed automobiles would have furnished terrible fuel, and the fire traveled beyond control, with grave loss of life unless the people could have moved off to the east and west out of the danger zone."

The armistice crowd was not frightened. It did not want to run away from anything, or get anywhere. Instead of trampling its neighbors, it wanted to put its arms around his neck, and let him dig it in the ribs, and make as much noise as possible. People in the skyscrapers, far from rushing to the streets in fear, mostly stayed where they were. They had good grandstand seats to see the fun, and could pelt the multitudes below with improvised confetti.

But suppose the signal that set this pandemonium loose had been, not a false newspaper report, but a catastrophe like an earthquake violent enough to cause panic—what then? It need not be a destructive earthquake. One severe enough to sway the skyscrapers, and rattle down a very little of the brick, stone, terra cotta and other building material suspended over the heads of people in the business district, might easily have that effect.

From that viewpoint, there is no place in the world like lower New York. The most severe panic, and the greatest panic hazard is in theatres. Downtown New York, roughly below the City Hall, is the largest theatre in the world, should anything throw its whole skyscraper population into a panic. People are seldom burned or suffocated in modern theatres, but crushed in the aisles. If there is fire, but no panic, seldom is anyone killed or even hurt. Downtown New York in an earthquake would be precisely the same. Few of the people in modern

buildings would be hurt, if any. But if a panic occurred, the problem would be strictly one of aisles, and probably great loss of life would occur in the aisles, or streets.

Let us look at this theatre and its "audience."

Figures of people at work and doing business between the City Hall and the Battery, Church and Pearl Streets, are largely estimated. But roughly, the skyscraper floor space in this district is between twenty-five and fifty times the whole ground area, and many more times the street or aisle area. The probable average number of persons in this district during the business day is estimated at one million to the square mile.

The tallest building, the Woolworth, houses nearly 12,000 persons, and 35,000 visitors additional enter the building daily. The building has twenty-nine elevators, and could probably be emptied in an orderly way in twenty to thirty minutes—the management makes no statement on this point, but that is a fair estimate measured by other buildings.

Capacities of Elevators Highly Important

The largest building in the area, the Equitable, has 11,000 tenants, and in addition, 115,000 persons visit the building daily. It is estimated that it could be emptied in twenty minutes, the elevators and fire escape capacity being such that the people could be brought to the ground floor faster than they could pass through twelve revolving doors to the street. (Naturally, in an emergency, these doors would be thrown wide open).

The Equitable building has thirty-seven stories, or forty-five acres of floor space. With 43,000-odd square feet to the acre, that is nearly 2,000,000 square feet, a good deal of it in corridors, elevator space, stairways—probably about 100 square feet of working space per person, not counting visitors. The four streets around the building have hardly 50,000 square feet of space, about standing room for the tenant population of the building. And it must be remembered that adjoining it on all four sides are other skyscrapers with dense populations. In the event of a panic, their tenants and visitors would start for the street too.

It has been found by H. F. J. Porter, an engineer who has made many investigations, that people crowding into the interior stairway type of fire escape, even though calm and orderly, will pack so tightly that movement is impossible. Human beings are like bricks in an arch under such circumstances, and the number of persons on the various floors of a large building, in ratio to the stairway space, is so great that if all try to use the stairway simultaneously, they wedge each other tightly. In panics, they wedge tightly enough to burst away the stair railings. These studies led Mr. Porter, some years ago, to devise the "horizontal fire escape" whereby a fire wall is run from top to bottom of a given building, old or new, and people pass to safety on each floor, instead of attempting to reach the street. It is seldom that a building of this character would take fire on both sides of the wall simultaneously. On each floor the openings in the wall are protected by fire doors which, in emergency, close automatically with thermostats, but not in such a way as to imprison people. This horizontal fire escape has been found particularly suited to institutions such as hospitals, and gives a high degree of safety even in old buildings.

Figures show similar conditions in other sections of downtown New York. A dozen skyscrapers around City Hall Park house more people than the city's entire population a century ago. Nineteen buildings facing on or located near Broadway, exclusive of the Equitable, have a business population, not counting visitors, of nearly 90,000 persons. As there are at least five visitors daily for each person in a skyscraper, these nineteen buildings alone have a daily "traffic" greater than the population of San Francisco. They are all handled in the elevators, almost without exception. Wherefore, elevators and their capacity become highly important in considering panic possibilities.

State of Mind a Telling Factor

Although an elevator is a much smaller vehicle than a street car, the 14,000 to 15,000 elevators in Greater New York carry 2,000,000,000 passengers yearly—which is more than are handled by all the subway and elevator lines in greater New York and the surface cars in Manhattan. Taking the Municipal building as typical, its elevators travel about 5,000 miles yearly per car. In an orderly way, the building could be emptied of its 5,000 workers in about ten minutes—and an expert subway guard would load and haul them all away in ten more minutes in three ten-car trains.

Of course, New York's elevators are scattered all over the city, but there is a very large percentage of them in the downtown skyscraper section, and their capacity to empty buildings is probably in the neighborhood of twenty minutes, on the average, assuming that the traffic were orderly. The tenant population of an office building, apart from visitors, is moved one way in about one hour each morning, and the other way during an hour in the afternoon. In an emergency, elevator traffic would be facilitated by the dispatch system that governs elevator transportation, and could be supplemented by orderly use of fireproof interior stairways.

Chief Kenlon holds that what would happen, in the event of a disaster making a deep impression simultaneously upon the downtown skyscraper population, would depend entirely upon state of mind.

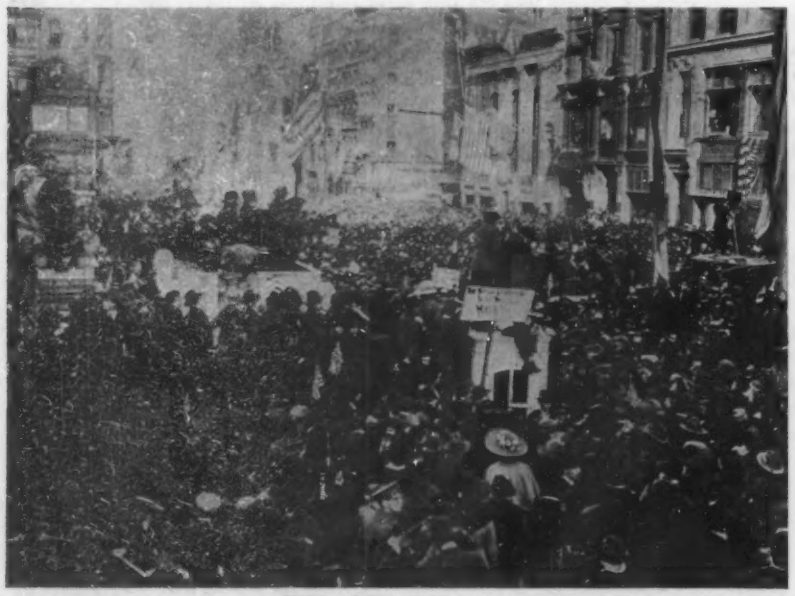
"Don't write me down an alarmist!" he says.

Mob Psychology

Six million crazed people on lower Manhattan. Self preservation the first law of nature. Each fighting for his life, with all reason completely gone. Such might well be the scene in a panic in New York.

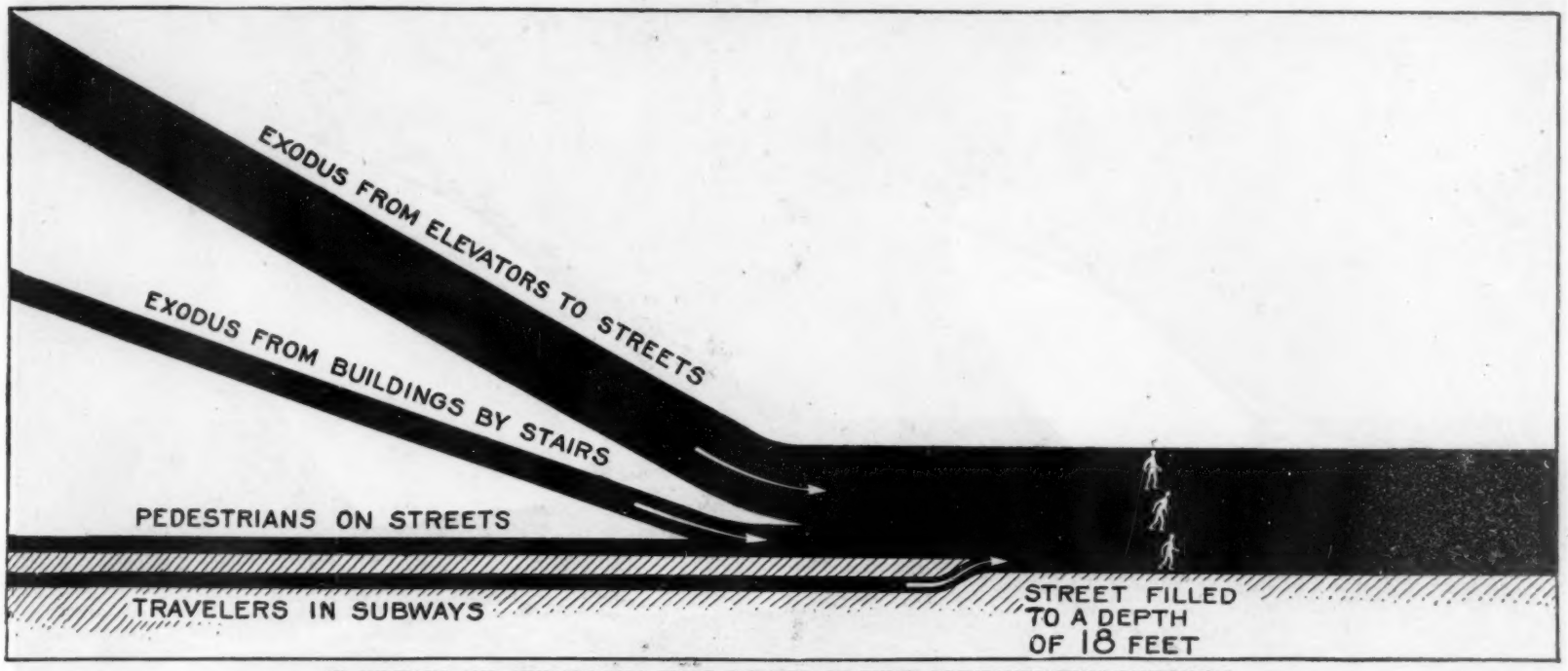
Every New Yorker, or anyone who has ever visited the metropolis must have noticed the strange effect mob psychology has; it overcomes even the most level headed individuals. This is most noticeable during the rush hours on the subway. Consider the mad rush, the reasonless panic, which completely overtakes the passengers of a crowded subway train in the event of an unexpected and threatening occurrence, such as the blowing out of a fuse and the burning of insulation with its attendant pungent smoke and flame. Then try to imagine the scene on every inch of downtown New York if suddenly the city was thrown into a real panic by sudden disaster, such as a violent earthquake.

Law, order and common sense completely gone? In this article by Mr. James E. Collins, Mr. John Kenlon, veteran chief of the New York Fire Department, who has had the opportunity to fully gauge the temperament of the New Yorker, in moments of disaster or near disaster, has some interesting comments to make on what would, no doubt, happen should New York City be rocked by a serious earthquake or shaken by a terrible explosion.



TWO ARMISTICE DAY CROWDS IN NEW YORK CITY SNAPPED BY THE OMNIPRESENT PHOTOGRAPHER

At the left: In front of the Central Public Library, at Forty-second Street. At the right: In front of the Sub-Treasury at the corner of Broad and Wall Streets. Note how the streets are so packed that no vehicle could possibly pass


EXODUS FROM ELEVATORS TO STREETS
EXODUS FROM BUILDINGS BY STAIRS
PEDESTRIANS ON STREETS
TRAVELERS IN SUBWAYS
STREET FILLED TO A DEPTH OF 18 FEET

IF SUBWAYS AND SKYSCRAPERS WERE EMPTIED OF THEIR OCCUPANTS SIMULTANEOUSLY

If, in an emergency, there were a general exodus to the streets of travelers in the subways and workers in the skyscrapers of New York City, pedestrians would be literally "three-deep"

"The chances for a disaster that would cause general panic in the skyscraper district are, in my opinion, very remote. Let us consider what the possibilities are of the occurrence of such a disaster:

"Would it be a great explosion? Under the regulations by which explosives are handled in the city, it could not conceivably take place in the city itself. The greatest explosion downtown New York has known in recent years was the Wall Street bomb outrage, which killed and injured many people outside the Morgan offices. It upset the routine of the financial district, but the great crowds that assembled were drawn entirely by curiosity.

"The Black Tom explosion during the war, over in New Jersey, occurred in the middle of the night. It was a terrifying experience, and might have had considerable effect upon the downtown section, but would hardly have caused a general panic.

Possibility of Destructive Earthquake Remote

"A conflagration spreading from building to building would be terrifying if large enough, and spreading with great rapidity. More than one speculative prophet has figured out how a serious fire in a gale might balloon flames from skyscraper to skyscraper, but the Department's answer to that is, that such a fire has started many, many times since New York's skyscrapers were built, but that every time we have put the fire out before the ballooning began.

"A sudden bombing raid, during war, might be a contingency, but conservative military opinion holds that this is one of the more imaginative horrors of war, because the destruction of the enemy's fleet and his armies are always the main objective.

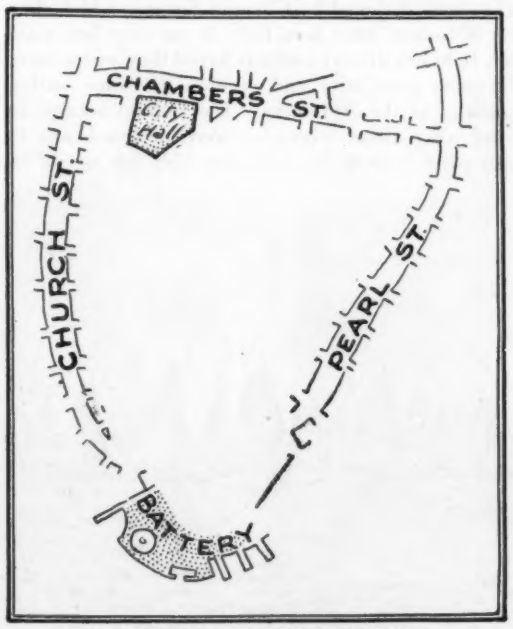
"So it seems to come down to an earthquake hazard. The earthquake of February, 1925, severely shook some parts of the city, but at night, when many New Yorkers were asleep, and the downtown section felt it more lightly than uptown.

"In my opinion, New York is in no danger of a destructive earthquake. The continental shelf from Cape Ann to Cape Hatteras runs off shore at a two-percent grade for two hundred and fifty miles. That shelf is nature's protection for our North Atlantic coast, as well as the country far inland. It is my belief that earthquakes are caused by rifts in the ocean bed due to the cooling and shifting of the globe. Such rifts are located in the deep waters of the Caribbean and the Pacific ocean, and cause disastrous earthquakes in well defined regions, such as the West Indies, Central America and Japan.

"But let us assume that an earthquake severe enough to rock the skyscrapers and bring down tons of their wall and cornice material did occur. That would be terrifying beyond doubt, and tend to create panic. New York's skyscraper population might conceivably start in alarm to reach the street, using the elevators and interior towers.

"In that event, the safest place would be the skyscrapers themselves, and the most dangerous place would be the street. People caught in the streets at the moment of shock, or rushing into them for perhaps several minutes later, would be in peril from falling material. People in old buildings of moderate height would likewise be in danger, for if the shock were severe enough, the structures would collapse. But while the skyscraper might sway and shiver, all earthquake experience with modern steel buildings shows that they withstand shock. There is nothing in them to collapse, except the outer walls, and practically nothing to endanger people inside. In an ordinary building with floor beams resting on brick or stone wall, the collapse of the walls means the falling of the floors. But the walls might be stripped from a skyscraper, and its beams would be intact, and its floors being really arches buttressed against the steel beams, could not fall. Whatever danger there might be of this kind would come from movables hung or piled up in offices.

"So, those who were busy at their work in the skyscrapers, and had presence of mind enough to stay where they were, would escape the two chief dangers of such a disaster—the danger of being hurt or killed in the street, and that of panic in the building itself. I believe that New Yorkers, besides being generally a cool-headed lot, know enough of the stability of skyscrapers to rely upon them in any emergency."



1,000,000 TO THE SQUARE MILE,

This is the estimated population in this downtown business district of New York City during business hours

Safety in High Buildings

Skyscraper history bears out this belief. In the very few cases of fire in New York's skyscrapers, there has been no uneasiness. In no case has a skyscraper fire ever spread beyond the few communicating rooms in which it started, for there is nothing in the building itself to burn—partitions divide it into a great number of fire proof compartments, and the only material to burn consists of office furniture and records. The Equitable building has had one small fire, the Woolworth building a small insulation blaze in an elevator shaft, and the Whitehall building at Battery Place a twenty-seventh floor fire that was confined to a few offices. Tenants who wished to leave the building passed down in the elevators in an orderly way, but many remained at their work, and a good many more did not know that there had been a fire until they read about it in the newspapers next day.

Architects' dreams for New York are wrapped up in taller and taller buildings—tower cities a thousand feet high or more, terminating in pinnacles, and set at such distances from each other that there will be ample natural light and ventilation around them.

It is logical to ask, "What would become of the people in such structures in case of disaster like a major earthquake?"

And the answer seems to be, "The higher the buildings, the more proof they will be against such disaster, and the safer people will be in them."

Alira *and* Oriole, *two of the famous New York Club "thirties" in a hard breeze*

Wind, Sail and Sea

Growing Popularity of Yachting in the Smaller Types of Boat

By J. Bernard Walker

Photographs by Morris Rosenfeld

LESS and less is yachting exclusively the rich man's sport; and when we say this, we have in mind yachts designed by naval architects and constructed by shipbuilders in the best manner. This bringing of the aristocrat's sport within the reach of the man of moderate means is one of the few advantages which have come out of the war. High costs of construction and the extortionate demands of the paid hand are eliminating the big yacht, until today yachtsmen of international fame who were familiar with the quarter-deck of the 90-foot sloop or the 120-foot schooner are perfectly content to hold the stick of a 30-footer or even of those "flivvers" of the sea, the 15-foot star boats.

The beautiful photographs which we show on these two pages exhibit strikingly the modern trend to small, seaworthy but fast racing cruisers. Holding the pride of place are the wonderful New York Yacht Club, Herreshoff, 30-footers which, although they were built in 1905, are today as sound in structure and as popular with yachtsmen as when they first spread their wings some twenty years ago. So staunchly were they built and so well have they been cared for that they are selling for a higher price today than when they were first turned out.

Schooners That Cruise or Race

This season sees the advent of a class of racing schooners, designed by Cox and Stevens, which, like the 30-footers, have been built in the very best manner, light but strong; and it is hoped they will achieve the same popularity and develop the same lasting qualities as the 30-footers. The general scheme in mind when these schooners were designed was to turn out a boat of the maximum size that would be comfortable for cruising, sufficiently fast for racing, and that could be handled by the owner and one paid hand. They are provided with the Marconi rig on both masts and, as our photograph shows, have both a smart and seaworthy look about them.

The dimensions of these schooners, of which sixteen have been built for members of the Seawanhaka-Corinthian and New York Yacht Clubs are as follows: Length over-all, 58 feet 6 inches; length on waterline, 38 feet; beam 12 feet; draft 7 feet 9 inches. The sail area must not exceed 1,400 square feet. Four people can find accommodation in a double stateroom aft, and on the full length transoms in the cabin. There is a large, self-bailing cockpit, from which all the leads can be handled.

And then there are the famous 6-meter boats which have provided such glorious international sport during the past few years. They are a devel-

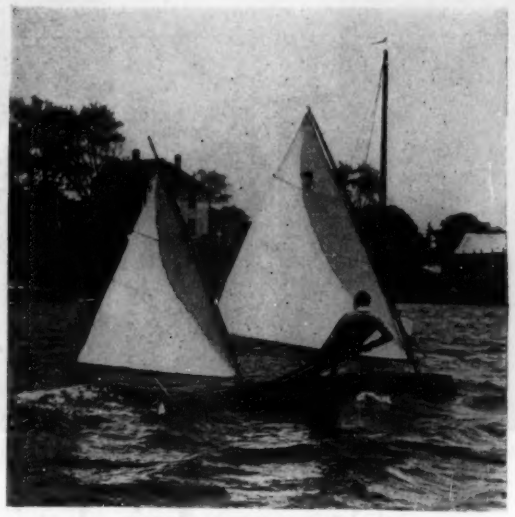
THE FLIVVERS OF THE YACHTING WORLD

These wonderful little craft, 15½ feet waterline, 281 square feet of sail, designed in 1906, are the most popular small boats in the world. It is not unusual for twenty or thirty to line up for a race

LANAI, A TYPICAL SIX-METER YACHT
Built to win the Seawanhaka Cup which is now held by the Scotch

opment from the popular 21-foot knockabout type which came out some thirty years ago; but, due to refinements in hull and sail plan, the 6-meter, within given restrictions of length and draft, is a much faster boat. In dimensions, they run from 19 to 23 feet in length on the water line, with a beam of about 7 feet, a draft of about 5 feet, and a displacement of between 8,000 and 9,000 pounds, the sail area being somewhat under 500 square feet. The racing last year in preparation for and during the British-American Cup contests was about as fine an exhibition of highly developed yachting sport, both as to the boats and the skill of their amateur skippers, as one could wish to see.

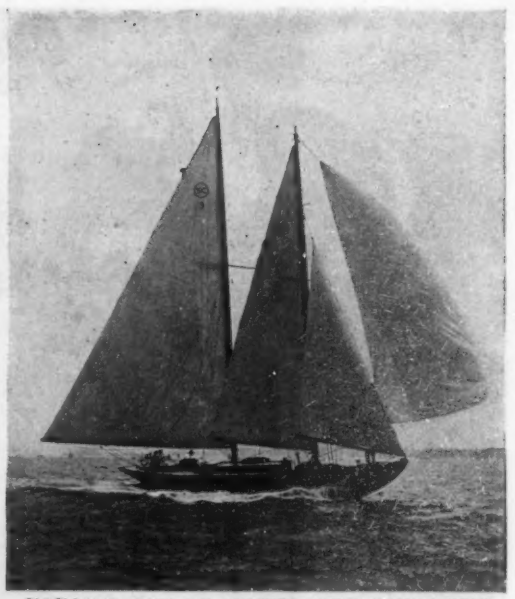
The British-American Cup went to the English, who were the first to win four races; but this year Clinton H. Crane, one of our most successful designers of small boats, has gone over to the Clyde with two 6-meter boats, *Lanai* and *Red Wing*, of his own design, in the endeavor to bring back the Seawanhaka-Corinthian Yacht Cup which was won many years ago by the Scotch and has been in various lockers ever since. In the contests for the British-American Cup, it developed that our boats were generally faster to windward or with sheets well aboard; whereas when sheets were started on a reach, or the boats were running down the wind, the Englishman would pull away. Consequently, in going after the Seawanhaka-Corinthian Cup, Mr. Crane has modeled the two boats with a view to increasing their reaching ability without reducing their speed on the wind. First, as you will see from



CHAMPION CANOE OF 1924
With sheets and tiller in his hands and sitting on an outboard sliding seat, this man has his work cut out

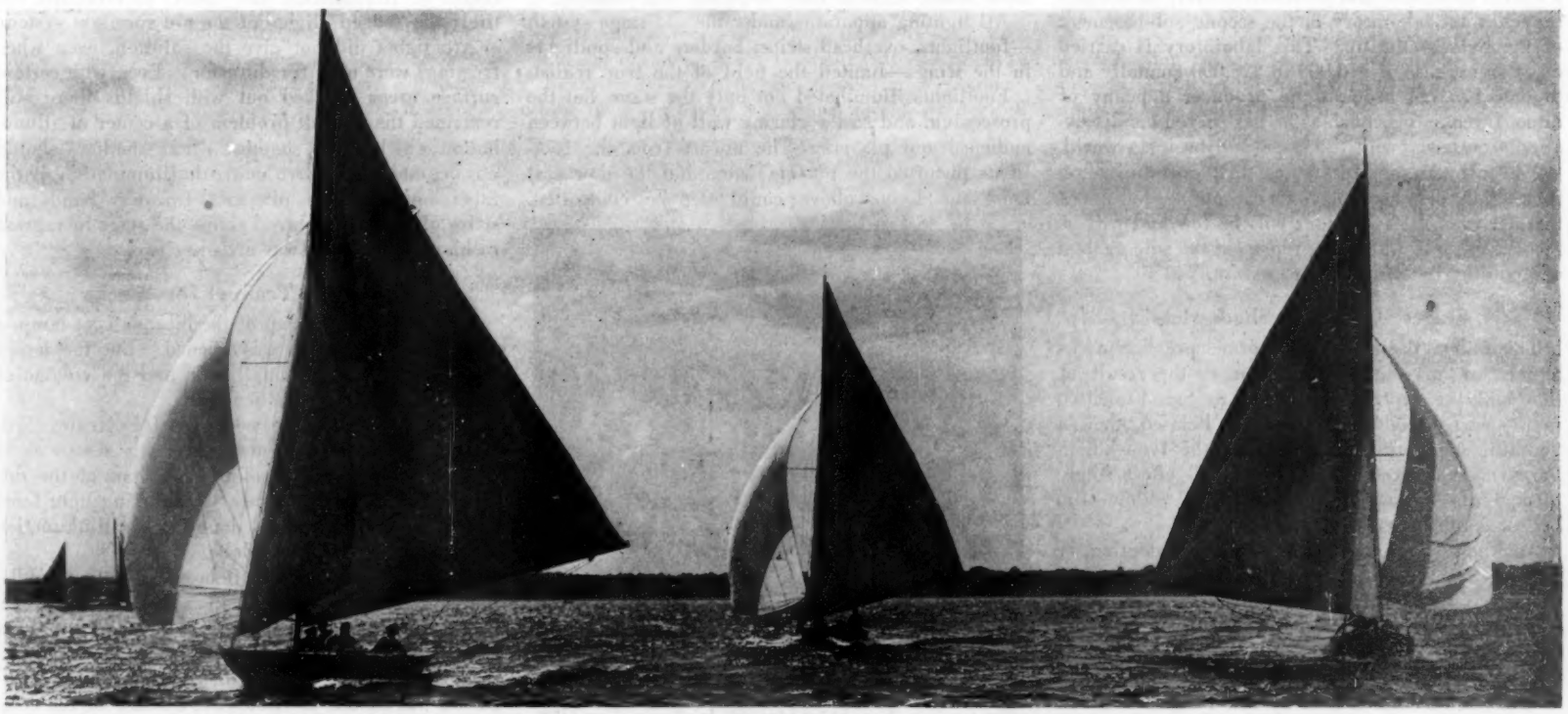
our illustration, they are considerably longer overall than last year's boats, are fuller in their forward sections and probably have a somewhat shallower hull. *Lanai*, which was built at Nevins Shipyard, City Island, is a thoroughly typical 6-meter craft. Her dimensions are: length over-all, 34 feet 6 inches, waterline length, 21 feet 9½ inches, beam, 7 feet 1 inch, draft, 5 feet 2 inches, sail area, 476 sq. ft.

In point of wide popularity and the great fleet of them which has been built, none of the smaller types of yacht can compare with what are known as the "Star" boats. Designed some twenty years ago, or

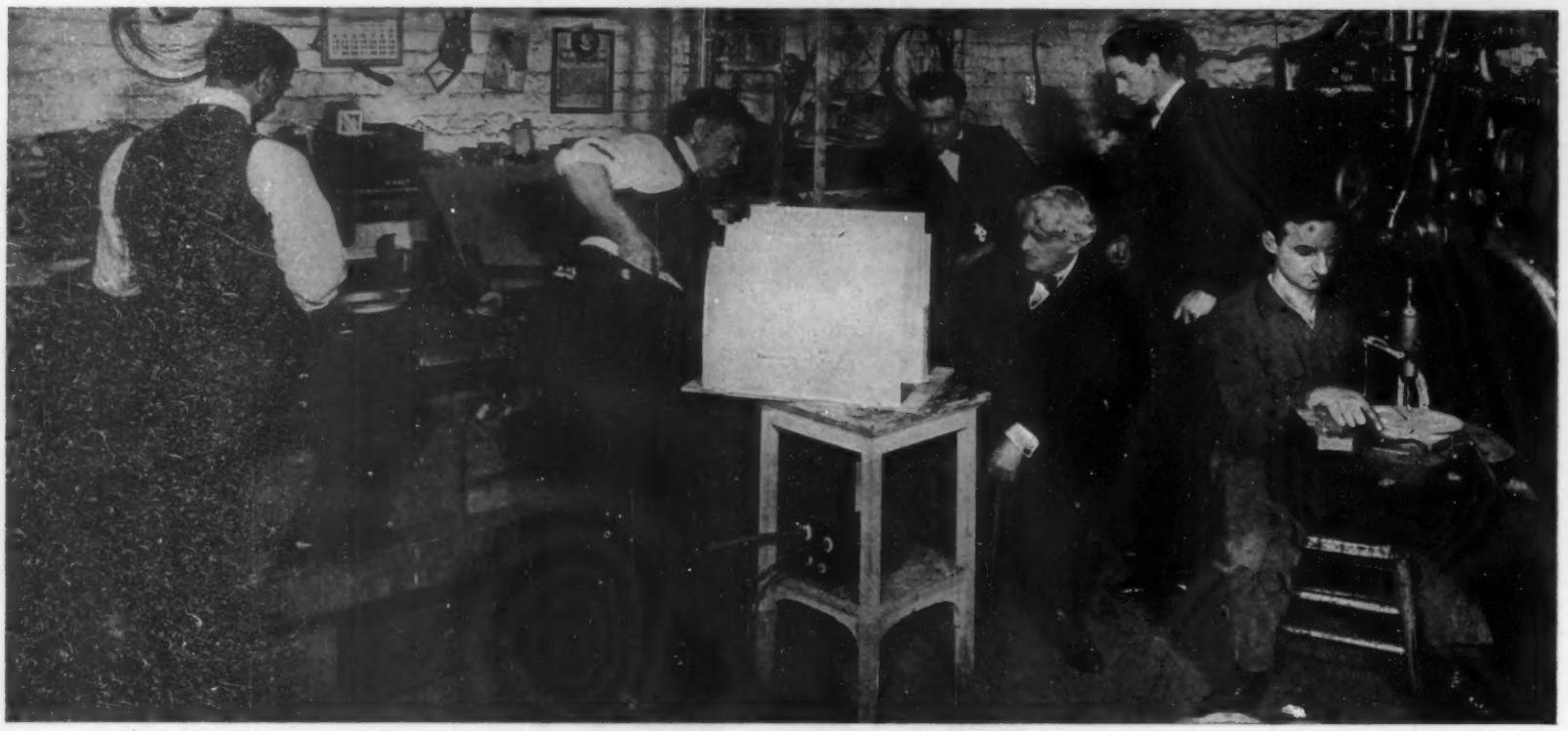


NOKOMIS, ONE OF SIXTEEN NEW SCHOONERS
Length on waterline 38 feet; over-all 58½ feet; beam 12 feet; draft 7 feet 9 inches

in 1906, by William Gardner, this little craft has been built in such numbers and in such widely scattered parts of the world that today nobody can tell just exactly how many of them are afloat, although it is conservatively estimated that their number runs up to 400. It is probable that Mr. Gardner himself had no idea of the international popularity which awaited his little 15-footer. From the very first, however, class racing between these boats became extremely popular and the demand for more of the type was insistent. Not alone on Long Island Sound and other American waters, but in practically every port of the world where small-boat sailing is a pastime, are to be found these wonderful little Star boats. They are 15 feet 5 inches on the water, 22 feet 7 inches on deck, 5 feet 8 inches in beam, with a draft of 3 feet 4 inches, and a sail area of 281 square feet. They carry a bulb fin with 850 pounds of iron. The original cost was 325 dollars. The cost is now 800 dollars; but they may be picked up occasionally for from 400 to 500 dollars.



DOWN THE WIND
Madcap, Firefly *and* Heron; *three of the six-meter American cup defenders*



Mr. Belasco experimenting with lighting effects on a miniature stage set in his lighting laboratory

The Impossible in Stage Lighting Is Achieved

How David Belasco Produces the Effect of Every Conceivable Sky Color, from Midnight Blue-black, Dusk and Moonrise Shadings to the White Light of Early Dawn

By John J. Wallace

CLIMAXING nearly a half-century of patient research and experiment, David Belasco, noted theatrical producer, has announced during the last few days the practical elimination of direct lighting from his stages.

Hereafter a system of reflected light will be used—a system developed and perfected entirely in his own experimental laboratory in the second sub-basement of the Belasco theatre. This laboratory is carried on at an expense of $18,000 to $25,000 annually and to date has not brought the producer a penny of direct revenue, inasmuch as he has shared his discoveries generously with the stage and business world.

Like all hard-and-fast rules, that governing "reflected light only" will have its exceptions; but under the new plan the exceptions will be few and will be recognized only when they represent the sole method of "holding the mirror up to nature."

Stages That Are Shadowless

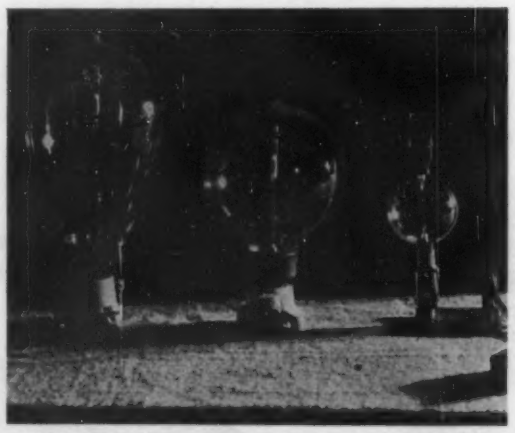
This radical departure from former practice marks a new era in stage illumination as the result of thousands of experiments begun in San Francisco in the early "eighties" when Mr. Belasco, then a youthful stage director, threw out the lypocodium boxes and achieved a thrilling "fire" effect solely through the use of strips of red and yellow silk, bellows-agitated, and lighted by flares!

Mr. Belasco's announcement of the adoption of reflected light from silvered, lacquered reflectors is the capstone of a lifetime of effort to effect illumination by diffused light, capable of concentration on an object or area without spill and without center of illumination such as direct light always gives.

What has been achieved by Mr. Belasco and Mr. Louis Hartman, his chief electrical expert, is a diffused light equal in value throughout its area, shadowless and melting out at the edges instead of ending in a sharply defined line. In addition it is a light which can be cast directly on an object in any form of desired light—circles, bands, crescents, oblongs, practically anything. Through its use a pathway of unbroken light can be cast along any desired portion of the stage, permitting players to move about without once stepping into shadow!

All lighting apparatus under the old stage system—footlights, overhead strips, borders and spotlights in the wings—limited the field of the true realist.

Footlights illuminated not only the stage, but the proscenium and cast a glaring wall of light between audience and players. The upcast from the footlights distorted the players' faces and the downcast from the lights above could not be controlled.



BELASCO'S EVOLUTION OF TUNGSTEN LIGHTS

Left to right: 1. One of the original tungsten lights made for street illumination. 2. The same light constructed so that four may be used in a bunchlight, giving about 1,000 candlepower. 3. Special double filament lamp for baby lenses. Note double sockets and opposed filaments

Added to this was the direct glare from the spotlights in the wings which cast heavy shadows—as well as heavy lights.

The problem was to obtain light from the natural direction—from above—and to obtain proper diffusion over a given area. Likewise it was desirable to concentrate the diffused light without an attendant center of illumination and lastly, to eliminate entirely the "edged" lights of the old spotlight system.

Arc lights did not give the solution, even when frostings were used for diffusion. Even with certain surface areas blocked out with shields there still remained the difficult problem of a center of illumination which threw shadows where shadows should not be, and which gave inartistic illumination of the faces and forms of players. Uncanny bands and strips of blackness played across the stage in vagrant fashion. The result was artistic chaos.

Operators Trained for Weeks

With the improvement of the incandescent lamp, a new field of research was opened. But the lamps were faulty, the filaments brittle and the volume of light too small for practical use.

Confronted with the necessity for greater brilliancy, Mr. Belasco turned all of his resources to this development. One of the solutions of the difficulty was a *double filament bulb* taking light from two separate contacts and doubling the illumination obtained from the same globe.

Another came when Mr. Belasco had a 200-candlepower light manufactured in a G-40 bulb which, because of its small size, could be assembled in units of four within one hood. Because of the long filament member the quality of greater *original* diffusion was obtained. Likewise, because of the compactness of the unit, it could be utilized from any position so as to be directed downward (the course

of natural light) instead of trying to reach the desired object with a glance-light from the side.

Then followed the Belasco "Baby" lens. Consisting of hood, light and lens, jointed on a standard for free movement, these were placed at the sides, overhead—each lamp controlled by a dimmer and with all the operations of each in the hands of a competent, trained operator.

It was a new departure, this multitude of individual lighting units, and to obtain perfect results it was necessary to train the men for weeks. Gone was the theory of a sole centrally-controlled lighting system. It had been broken up into units.

Concentric rings, graduated in size—known as louvres—were added to the equipment to control the lights and eliminate shadows, and by the use of gelatine members, further diffusion as well as color-tones were effected. But the gelatines faded under the fierce heat and light. Continued replacements and varying colors due to fading irked the artistic sensibilities of the producer and, while the business world was grasping at the new plan, Mr. Belasco made another discovery—silks as a diffusive medium.

Months of Weary Experimentation

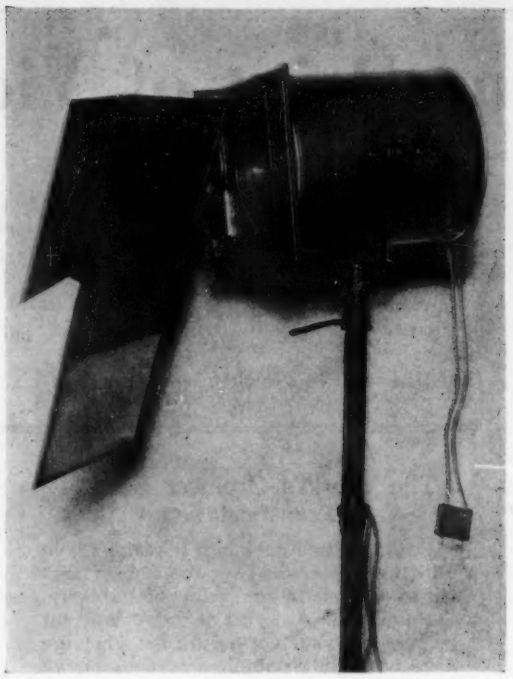
Instead of the faulty gelatines, Mr. Belasco and his staff placed silken lighting filters before their lamps, reducing center of illumination by yet another fraction and increasing the diffused field enormously. Then came the discovery that by coloring the silken filters and allowing for light absorption by the various objects, colored light could be projected—and in a large measure controlled.

Anyone but David Belasco would have been satisfied, particularly after he produced the remarkable "Heaven-reunion" scene in "The Darling of the Gods" with colored lights thrown entirely against white backgrounds, developing cerulean blue, gray-white clouds, spiritualized flesh colorings and shadows solely by the use of lights.

But commercial lighting had reached a degree of intensity which demanded a brighter stage lighting and a sufficient amount of light could not be forced through the silken filters to meet this need.

Patiently Mr. Belasco turned to experiments with silver-surfaced reflectors. It became apparent quickly that at last they had touched the outer edge of the great secret. The "Baby" lamps, casting strong white beams from their lenses gave 1,000 candlepower light, more than enough to cast an equal reflected light over any given area.

Unfortunately, like the arcs, they gave a disheartening spread of illumination. Therefore, it became



ANOTHER BELASCO PRODUCTION

A "baby" lamp, with louvres and hinged color reflector for use in the new Belasco system. The lens points away from the audience and the reflector projects onto the stage

necessary to evolve a plan for forming light-projection into shapes. This was accomplished by cutting the reflecting members into oval shapes and giving them a certain degree of "bow." The result was that by turning the bent reflector in various positions before the lights, any form could be produced.

Still Mr. Belasco was dissatisfied. He wanted not only colors, but tints in the lights. He demanded, for example, that a reflector be made which would duplicate all of the colors of a full 24-hour day, with their variegated shadings. So a lacquered reflector was made bearing the needed colors in scientifically arranged colored bands across its face.

Then one day a critical group saw Mr. Hartman throw moonlight on a blank white wall, dissolve it into the blue blackness of the night before dawn, bring out dawn's misty gray, followed by the silver of the sun's first rays; the brilliant morning sunshine, noon's sullen yellow, then late afternoon, sunset, dusk, darkness, moon-rise and full moonlight!

Nowhere in the light was there visible shadow; center of illumination was down to the irreducible minimum and the area of the light value was equal throughout. Best of all, the light was practically "edgeless," melting into its surroundings by absorption.

Then came another discovery. Plane surfaces give flat refraction, but a hummocky plane would recross the rays anew, adding to diffusion and eliminating practically the last vestige of center of illumination. The result was a crossed and recrossed light giving equal values to all portions of the lighted area.

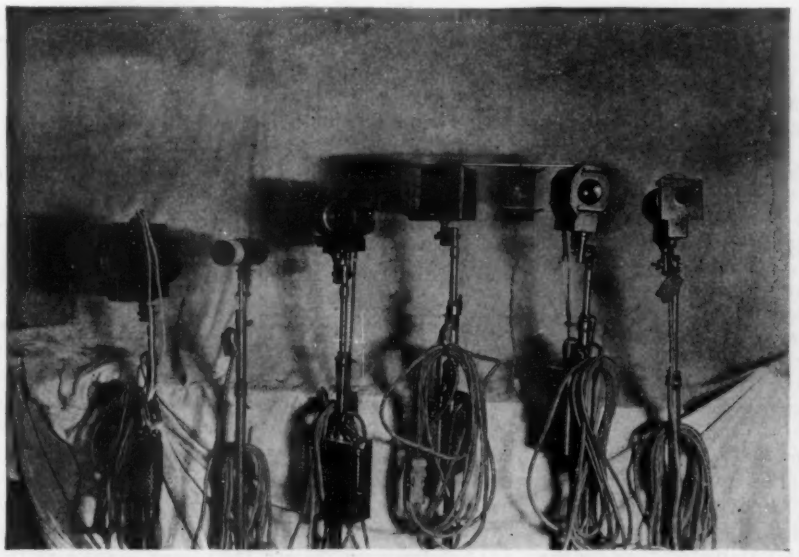
Months of weary experimentation elapsed before success was achieved. The difficulty of the problem was increased by variations in pigments, the action of the long rays in contrast to the short rays of light on various surfaces, and the absorption of color by the object illuminated. It was necessary to develop a secret pigment combination for the lacquer and to work out a table of focusing and reflector movement in order to produce tints of colors.

No Exposed Light Ever Visible

Varied intensities of light are obtained under the new system by changing the focus of the lamp within the projector-hood, enabling the operator to cast identically the same quality and quantity of light on a performer either directly before the light or many feet distant. This is aided by dimmers, so delicately adjusted that more than 200 "steps" or variations are possible from "bright" to "out" in each of the lamps. As a result there is a rule that henceforth no lamp may be used on a Belasco stage until it is under control by a dimmer and no exposed light ever may be shown.

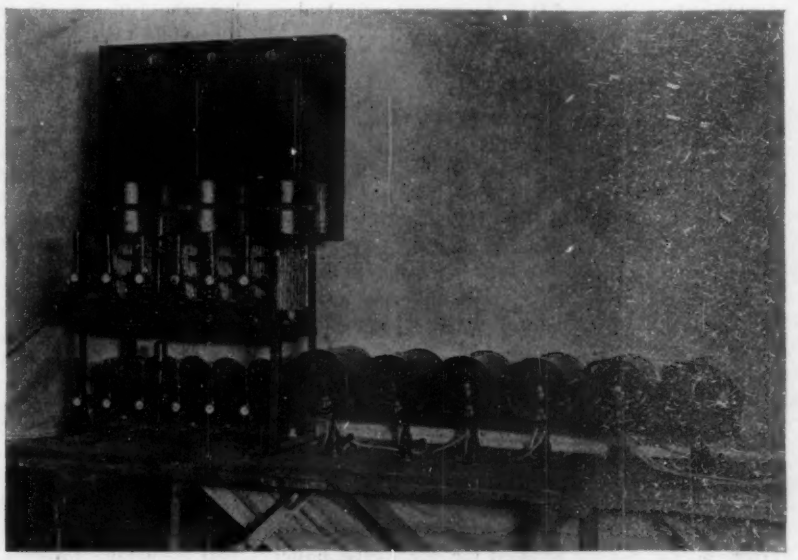
As a result, Belasco stages are shadowless, except where realism dictates that shadows must be. Then the shadows are made and laid down by lights utilized solely for that purpose.

To make the system a success, total elimination of footlights and reconstruction of the entire stage lighting apparatus was necessary. Front lighting is given from a hidden unit in the center of the gallery, lighted only when the curtain is up. Two other units on the upper balcony merge with and add to the lights from the first unit, at the same time killing whatever shadow the first unit might cast. The overhead border-lights consist of seven separate sections, each connected on separate resistance, enabling full lighting or shadowing as desired. There are five sets of border lights, 270 lamps in each, and scores of connecting pockets in fly galleries and upon the stage to permit suitable attachment of the reflector-lamps at any needed point.



A GROUP OF BELASCO BABY LENSES

From left to right, our photograph shows a 500-watt baby lens, a 150-watt baby lens, with six-volt lamp, a 250-watt baby lens for use with louvres, a 250-watt reflector with louvres, a 150-watt footlight baby lens, another type of 25-watt baby lens and a special diffusive light



NO LONGER THE FOOTLIGHTS

The external Belasco lighting system installed on a balcony front. This equipment has made possible the total elimination of footlights and has brought about a reconstruction of the entire stage lighting apparatus. This is a unit complete and ready for installation

Our Point of View

Steam Turbine Still in the Ring

THE internal combustion engine is having a great vogue just now in the field of the merchant marine. As compared with that good old reliable, the steam engine, it almost seems to be a case of "The King is dead. Long live the King!" But is the King dead? There are some of us who think he is still very much alive; and among us is no less an authority than the Honorable Charles Parsons, the inventor and indefatigable developer of the steam turbine. Sir Charles has recently made a comparison of four 14-knot freighters driven by four different types of motive power: quadruple-expansion reciprocating engines with Scotch boilers; geared turbines with Scotch boilers; internal combustion engines; and high-efficiency geared turbines with water-tube boilers. All four types develop 5,000 shaft horsepower. High efficiency turbines, representing the latest possible practice, include water-tube boilers with steam at 500 pounds pressure superheated to 700 degrees F. The turbines are triple-expansion, running at 5,000, 3,000, and 1,700 revolutions, and coupled through double-reduction gearing to a propeller shaft running at 90 revolutions per minute. The contest, of course, lies between the internal combustion and the highly developed steam turbine installation and the steam turbine wins. Its machinery weighs 670 tons as against 1,100 tons for the internal combustion engine. The turbine outfit requires 430 tons of oil fuel, as against 300 tons, but the weight of machinery, fuel and reserve water is only 1,200 tons as against 1,445 tons. The wages of engineers, firemen, *et cetera*, per voyage are 1,730 dollars for the turbine as against 1,910 dollars; and the total cost per annum is 188,400 dollars as against 211,500 dollars for the internal combustion plant. The above figures are for oil-firing; but if coal is used on the turbine-driven ship, the total cost per annum would drop to 144,550 dollars; and it should be noted, by the way, that the ship equipped with reciprocating engines, when burning coal, would cost to run only 171,250 dollars per annum. King Oil is a lusty young monarch; but evidently, if the estimates given in above comparison are correct, it will be many a decade before the world pronounces the final obsequies of King Coal.

Coal Conservation

COAL conservation must be achieved not only at the mine, but by the consumer: the first, by better methods of mining; the second, by better boiler and engine practice. To learn how this can be done consider the new locomotive "Horatio Allen," which is now in operation on the Delaware and Hudson Railroad. Our railroads are enormous consumers of coal; and the average locomotive has not only been a voracious coal consumer, but it has been most uneconomical in transforming the energy of the coal into draw-bar pull.

Today, locomotive engineers are attacking the problem from many angles, and Mr. John E. Mulfield, designer of the Delaware and Hudson locomotive, by breaking away from the shackles of tradition, has built a locomotive which has proved itself to be a truly remarkable coal saver. In the first place, he has boldly adopted the water-tube boiler, building it in the form of a fire-box, which, by the way, is of unprecedented size. By using a long fire-brick baffle wall, he secures excellent combustion with maximum radiant heat effect before passing the gases through a cylindrical locomotive boiler which is formed integrally with his water-tube fire-box. Other elements of economy are the use of 350-pound boiler-pressure, superheated steam, and multiple-expansion cylinders with large valve and port openings.

He tells us that in 1915, the typical, large, freight locomotive of his road consumed 160 pounds of coal in moving 1,000 actual gross ton-miles, and that with his new engine, the same ton-mileage, under similar operating conditions, requires 55 pounds of coal. Looking forward, Mr. Mulfield expresses the opinion that, by using powdered coal, by reheating the high-pressure exhaust steam, by increased train loading with the use of an auxiliary locomotive, by utilizing the weight of the tender for tractive purposes, by substitution of poppets for piston valves, *et cetera*, it will be possible to bring the consumption down to 38 pounds per thousand ton-miles, or less than one-quarter of the coal consumption in the standard freight engine of 1915. Since 90 million tons of fuel are now used in freight hauling, there would be effected an annual economy of about 200 million dollars. Ho, ye superintendents and master mechanics,—get busy!

The World's Greatest Feat of Transportation

Posterity will not claim that the age in which we live was over-modest or lacking in a sense of the value of publicity. Certainly, the America of today will not be subject to such criticism; for when we have wrought a notable achievement, we are not slow to proclaim the fact. But in the field of transportation, America has accomplished a feat the importance, we had almost said the splendor, of which seems not to be fully understood by the average, work-a-day citizen. We refer to the United States Air Mail Service, and particularly to its later developments, the Transcontinental Air Mail Service and the night service between New York and Chicago.

We hear too little about this truly great feat of transportation, unrivaled as it is by any air service in Europe, where it receives, by the way, the admiration which is its full due. Look at a few of the figures. During the six years covered by the service of the Air Mail, over 255 million letters were carried and the total number of miles flown was just under 7 million; and all of this was done with an average operating efficiency of 91.82 percent—a result truly marvelous if we only bear in mind that the service is maintained day after day throughout the year, and that, in the six years' period, some 15,000 trips were made in the stress of thick or stormy weather.

On July 1, 1924, when the through transcontinental service was established, the rate of efficiency actually rose, in spite of the fact that flight was continuous day and night. A mail plane starts each morning from New York and San Francisco shortly after the breakfast hour, and at five o'clock in the evening of the following day lands its mail, after thirty-two and one-half hours of flying, at the desired Atlantic and Pacific terminals. Congress has been very sluggish in recognizing this great work. It will move only when the voters of the country demand the immediate passage of such legislation as is fundamentally necessary to the broad extension of commercial aviation in the United States.

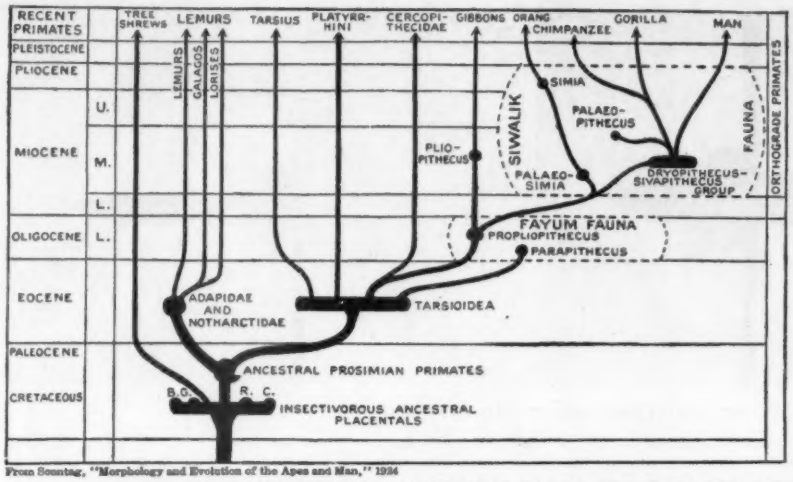
Progress in the Oil-pollution Problem

WE have been asked if any positive action is being taken to stop oil pollution of navigable waters. We are glad to be able to say that very definite steps are being taken. An Inter-departmental Committee has investigated the subject exhaustively, principally through the Bureau of Mines; but it was realized that before the President called a conference of maritime nations on the subject, this country should be in a position to submit definite proposals. Accordingly, a technical investigation has been carried on by the Bureau of Standards to discover some practical device or process by which oil pollution could be prevented. This investigation has involved laboratory research, field investigation, testing of devices, inspection of oil-burning vessels, and particularly the observation of oil-separating devices installed upon oil-carrying ships. Lastly, a study has been made of the effect of different percentages of oil discharge on fish life. It is gratifying to know that tests made aboard ship on the high seas and in foreign ports indicate that efficient oil separators may be produced. As soon as there are sufficient well established facts in hand, the President will lose no time in calling an international convention.

Rebuilding the *Constitution*—A Suggestion

OUR daily mail bag brings the gratifying assurance that our appeal for funds to rebuild the *Constitution* has awakened a widespread and very intelligent interest. From far Duluth comes a valuable criticism of the existing battery as mounted on the *Constitution* today. It consists of 54 heavy 24-pounders. This, of course, does not correctly represent the original battery. The *Constitution*, when she fought the *Guerriere* mounted thirty long 24-pounders on the gun deck; and on the quarter-deck and forecastle two long 24-pounders, one long 18-pounder and twenty-two 32-pounder carronades. A long "24" weighs about 4,750 pounds; but the carronade was a short light gun of large bore, designed mainly to fire case shot or shrapnel at close range.

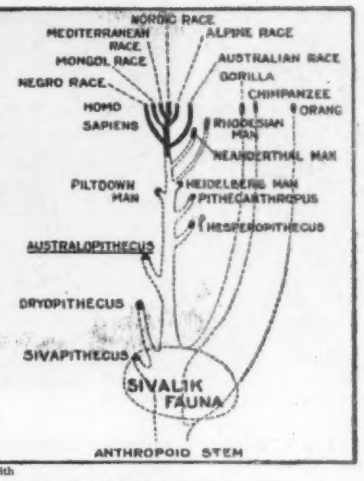
When the *Constitution* was reconditioned in 1906, the Government found one of her old 24-pounders: and for convenience they cast 54 guns from that pattern. Our correspondent, Mr. Edwin B. Eddy, Jr., suggests two reasons why the ship should be armed as in 1812: first, for the sake of historical accuracy and, secondly, because the change to the lighter carronade would relieve the vessel of from 57,000 to 68,000 pounds of weight, thus easing the stresses and giving her a better chance to remain true to line and form as the years pass by. In this connection we wish to mention that in reconstructing *Old Ironsides*, every bit of the timber of the ship of 1812 that remains in her (and there is some of the original oak still in place) and is still in a sound condition, will be religiously retained and built into the reconstruction of 1926.



From Sonntag, "Morphology and Evolution of the Apes and Man," 1924

THE FAMILY TREE OF MAN AND THE TAILLESS APES
(READ FROM BOTTOM UP)

POST-GLACIAL	CAVE ART IN EUROPE.
PLEISTOCENE EPOCH	NORTHERN EUROPE GLACIATED SEVERAL TIMES, BUT MAN EVOLVING SOUTH OF ICE.
PLIOCENE EPOCH	EARLIEST AUTHENTICATED FLINT INSTRUMENTS. TIME OF APE-MAN. TIME OF MAN-APE.
MIOCENE EPOCH AT LEAST 1,000,000 YEARS AGO, PROBABLY MORE	COOLER AND DRIER CLIMATE. LARGE APES EVOLVING RAPIDLY IN UNFORESTED AREAS. GRASSES REPLACING FORESTS, GRADUALLY COOLING CLIMATE. WIDESPREAD FORESTS. WARM CLIMATE.



Tree redrawn from the "Illustrated London News", after Prof. G. Elliot Smith

THE TREE-LIVING COMMON ANCESTOR OF MAN AND THE PRESENT-DAY MONKEYS WAS AN ANCIENT NEAR-MONKEY

These tables represent, with minor differences, the consensus of present-day opinion concerning the genetic relationships between the respective primates. Whatever changes they may receive, due to future investigations, it is certain that they will show man's descent through several ancient forms not widely different from the modern monkeys and large apes

Did Man Descend from Monkeys?

The Unqualified Denial of Man's Ape-like Origin Is Misleading and Lacks Candor

By Albert G. Ingalls

ARE we always to go on compromising with expediency concerning what we teach about man's ancestry? Are the scorning shafts of the fundamentalists so sharp that they drive us to refuge behind equivocation? Would the future right to teach the truth about science be jeopardized by teaching now that man's ancestor was an anthropoid ape, and earlier still was practically a monkey? Must we, to be specific, go on asserting in lectures, in magazine articles, in popular primers of science, and even in high school text-books, the technically true but decidedly misleading catch phrase that "man did not descend from any *known* monkey, but that man and the monkeys are only collateral descendants from a common ancestral stem?"

True it is that man did not descend—could not possibly have descended—from any of the living monkeys, and true it also is that both man and the living monkeys descended from a common stem. These statements do not, however, come near representing the whole truth candidly. The common stem was itself like a monkey and later like an anthropoid ape.

However, it is difficult to pin down the loose term "monkey," since few people think of the same group of primates when that word is spoken. According to the Century dictionary, the word "monkey" includes in its content all of the order of primates except man and the lemurs. The word "ape" agrees in its general sense with the word "monkey," but is more limited in its specific sense. In its technical sense, prefixed by the word anthropoid, it has reference, usually, to the family of the *Simiidae*, that is the gorilla, the chimpanzee, the orang and the gibbon.

In any case, the question regarding which particular genus of the order of primates any given person regards as monkeys—whether the *Simiidae*, which I find is the mental equivalent of "monkey" in the minds of quite a number of people; whether the baboons, mandrills and macaques; whether the little South American monkeys of the Italian organ grinder; or whether all of these primates are monkeys, makes little difference in this consideration. Animals *not very widely different* from them—from the layman's viewpoint—have undoubtedly had their place at one time or another in our ancestry, depending on how far back in time we proceed.

Were it possible for us to go back a few million years and actually to see our mid-Tertiary Period ancestors, we should find no better, no more descriptive, popular term for this "common stem" than ape or monkey. We might maneuver around the use of the objectionable word by some more scientific term; but the fact would still remain that our ancestral animal had many of the characteristics of the monkeys and anthropoid apes of our times.

Let us then be frank and not designate our ancestor by some misleading phrase if we mean thereby to give the impression that the "common parent stem" was a much more noble creature than the living apes and quite different from them.

Teaching Only a Diluted Darwinism

It is true, the ancestral anthropoid ape, and further back in time, the ancestral tailed monkey, was not identical with the living monkeys. Neither branch of the descent from these animals remained unchanged, unevolved, down through the epochs. But while the one branch, the hominoid, evolved very decidedly, the other branch, probably because it remained in a too comfortable environment which gave little urge toward evolution, remained comparatively unchanged in its salient characteristics. That is why we can here assert that man's ancient ancestor so closely resembled some of the living monkeys that most of us, unless especially trained in mammology, would discover little characteristic difference to distinguish between the two.

To many it may have seemed more politic, better strategy, in the present warfare of fundamentalism against religion and science, to temper the raw fact of man's descent from the brute, and to emphasize at present only a part of the story, withholding the rest for a later date.

Should we do this, or should we hew to the line?

It must be clearly pointed out, that it has not been science which has issued this kind of diluted Darwinism; at least, it has not been those scientists whose work lay in the realm of anthropology. Rather it has been popular writers, and particularly those who have felt it necessary at all times and at all costs to find some defense for evolution. Thus, they have fallen into the error of greatly broadening the technical fact that our ancestral common stem was not precisely like any of the living monkeys. In this connection, the biologists and other scientists whose works is allied to evolution have said little. Real scientists love peace and hate controversy. They remain, mostly, inarticulate, believing that in time truth will prevail.

Science presents presumptive evidence that our line of ancestry branched off from the tree of the suborder, Anthropoidea. Trace it back and, according to the majority of paleoanthropologists, you meet with the ancestors of the living *Simiidae*. Back further you meet with the ancestors of the baboons, mandrills and macaques *(Cercopithecidae)*. Further yet you find the ancestors of the New World monkeys *(Platyrrhini)*. A few trace it directly to the ancient tarsioids.

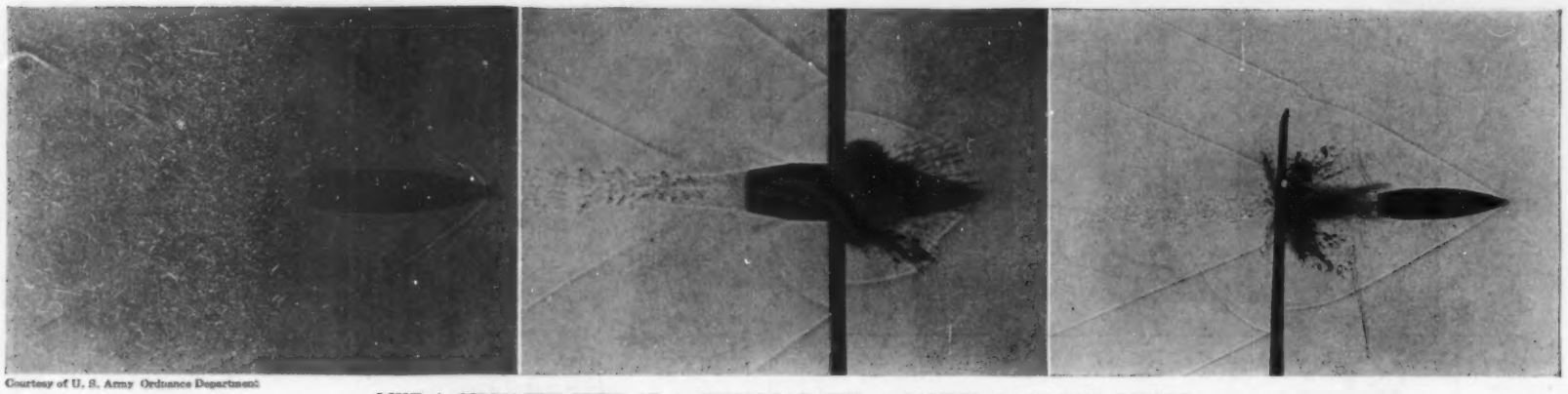
The fact of man's descent *through* several monkey-like forms seems inescapable.

A committee consisting of the nine presidents of the state universities and leading colleges of California, appointed by the Board of Education of that state for the purpose of investigating text-books, approves the assertion made in one of the text-books under judgment, that "evolution does *not* teach that man is descended from a monkey."

Of this too reassuring pronouncement, *Nature*, the well-known English scientific journal, rightly says, "It is significant of the strength of the anti-evolutionary movement in the United States that this committee, the chairman of which is president of the University of California, should endeavor to appease public opinion by its approval of such a misleading assertion, which suggests that the members of the committee are in favor of teaching only a diluted Darwinism."

The Scientific American agrees with *Nature* that the statement in question is misleading; though we do not believe that the California committee, composed chiefly of scientists in other than the biologic sciences, intended to mislead. The misleading statement has, in fact, been made so frequently and by so many writers that belief in it has become almost fixed.

Darwin states, without equivocation, in *The Descent of Man*, Chapter VI: "The Simiadae then branched off into two great stems, the New World and Old World monkeys; and *from the latter*, at a remote period, Man, the wonder and glory of the Universe, proceeded."



Courtesy of U. S. Army Ordnance Department

LIKE A BIRD'S-EYE VIEW OF A SPEEDBOAT, THE .30-CALIBER BOAT TAIL BULLET

AT LEFT: *This bullet is traveling 2,700 feet per second. Note the bow and stern waves, and the wake of churned air in the rear; the white lines adjacent to the sides of the bullet indicate rarefied air due to its spin.* CENTER: *Penetrating cardboard, the bow wave is reflected back as sound; a new bow wave is being formed in front. The fragments of cardboard are traveling faster than the bullet.* AT RIGHT: *Free of the card, the bullet outdistances the fragments, each of which has its own sound wave. A new bow wave is now established*

Tagging a Bullet on the Wing

A New Apparatus that Photographs the Flying Bullet in Less than a Millionth of a Second

By Capt. S. P. Meek

Ordnance Department, U. S. Army, Frankford Arsenal

IN THE early days of the use of projectiles the problems of ballistics were not a subject for study on the part of anyone except the individual who was using the weapon. The hurler of a missile or the archer who discharged an arrow could easily follow its line of flight and determine for himself the various factors influencing its trajectory and make due allowance for them in the next shot; provided, of course, that his opponent had not made the correct allowance on his first shot.

With the advent of gunpowder, however, projectiles began to diminish in size and to increase in velocity, with the result that they could no longer be followed by the unaided eye. It was presumed at this stage that by using a bullet of the same characteristics and an equal powder charge, each projectile fired would follow close to the trail of the preceding one; for it was supposed that the factors influencing these two shots fired under similar circumstances would always be similar. This brought into being the study of ballistics, the science of the motion of projectiles.

For many years the ballisticians contented themselves with observing the point of strike of the bullet and deducing from this the force and importance of the wind, and other factors. An early improvement on this method consisted in putting up a series of paper screens or targets, and firing through them. This enabled the trajectory or path of the bullet to be more accurately determined. From the supposition that each bullet took approximately the same path, its probable point of strike could be easily predicted. However, what was actually transpiring in the immediate vicinity of the bullet at any given instant was still unknown.

Probably many ballisticians had an idea that they could make wonderful discoveries if they were only fast enough to run alongside of the bullet and observe what was taking place, or if they could even examine accurately the bullet and its surrounding phenomena at any one point of its flight. The first part of this problem has so far not been solved, but it is indeed a rash person who in the present day would say that anything is impossible.

Crude Photographs as Early as 1860

Although it was not at that time (nor is it now) practicable to move alongside the bullet and observe it, it occurred to some ballistician about 1860 who had an exceedingly active imagination and a total disregard for the human limits of experimental possibilities, that it would be a clever idea to take a photograph of this bullet, and to take it so rapidly that the bullet would apparently be standing still. Probably this man was laughed to scorn by his contemporaries, but nevertheless he persisted and eventually succeeded in obtaining some poor and crude photographs of the bullet while in flight. This man was Töpler and his method was known as the *"Schierenmethode,"* or streaked method.

As is usual, once the possibility of photographing the bullet had been definitely established, a host of the very scientists who had been deriding Töpler, promptly took up the idea and proceeded to improve his apparatus. Progress was slow, and until 1914 Töpler's method, with only very slight improvements and modifications, was the only method in practical use.

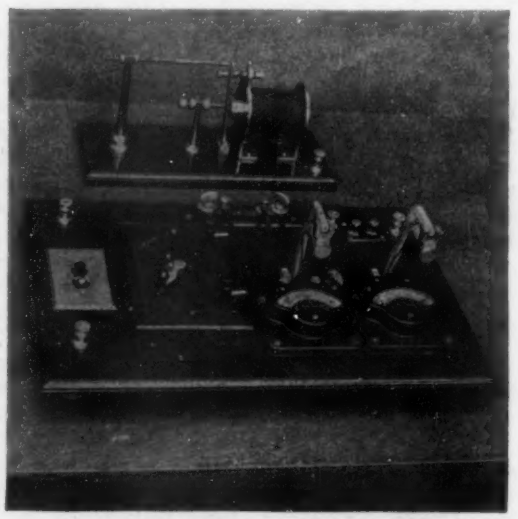
About this time Dr. Bruno Glatzel published a pamphlet entitled *"Electrische Methoden der Momentphotographie"* (Electrical Methods of Instantaneous Photography), in which he reviewed various existing methods and proposed some new ones. His death at the front at Verdun took away one of the foremost German students of this subject. Some work was also done by Professor Boyes in London on the same subject, with good success.

In 1919 the Ordnance Department of the United States Army started to secure photographs of some of the service bullets in flight. This program was entrusted to Mr. George A. Miller, Jr., Metallurgist at Frankford Arsenal. Previous work in this country had been done principally by Professor Dayton C. Miller, Case School of Applied Science. Mr. George A. Miller met with considerable success in his attempts and secured some remarkably good photographs. His connection with the Frankford Arsenal, however, was unfortunately terminated by his resignation in February, 1922, and the problem was halted temporarily.

In December, 1923, in connection with the development of international rifle match ammunition, it became desirable to have some photographs taken of the Frankford Arsenal ammunition, and the author was assigned to this problem. As it was a rush job, Mr. Miller's apparatus was hastily assembled and photographs of a sort were taken. The problem proved of such interest that the Ordnance Department allotted funds for further experimentation, with the result that at the present time

FIRING THE SHOT ELECTRICALLY

The United States Army rifle, clamped in a mechanical rest. Note the magnetic solenoid for "squeezing" the trigger



THE AUTOMATIC TRIGGER FINGER

When switch is snapped, relay closes a secondary circuit which includes an electro-magnet. This pulls the trigger

Frankford Arsenal has a most complete and up-to-date equipment for the taking of pictures of bullets at velocities over 1,800 feet per second. With slight modifications, lower velocities also can be taken.

When it is considered that a bullet traveling at a rate of 2,700 feet per second will travel 32,400 inches in one second, and that the maximum movement permissible in order to obtain a clear photograph is about 1/100 of an inch, it will be seen that the limit of exposure of the plate is approximately 1/3,000,000 of a second.

The best flashlight powder made in this country will not give an illumination shorter than 1/10,000 of a second. No shutter or mechanical device will operate much faster with any certainty or accuracy of control.

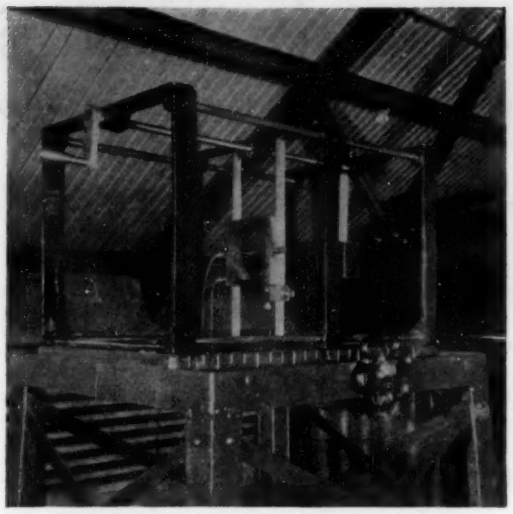
Exposure, One Three-millionth of a Second

Thus, it is evident that ordinary photographic methods will not suffice for the attack on this problem. When, however, we enter the realm of high-frequency electricity, we find that it is comparatively easy to make a circuit that will have a natural frequency of oscillation of 1/3,000,000 of a second, or even less. It is on this principle that the apparatus at Frankford Arsenal is based.

The gun used for firing the bullet is an ordinary Springfield rifle, equipped with a pressure barrel and a reduced trigger pull. This rifle is mounted in a machine rest, which in turn is set on a heavy concrete base in order to avoid vibration as much as possible.

The bullet used in the experiments described in this article is the 172-grain, nine-degree boat-tail, gilding metal-jacketed bullet designed and manufactured by the Frankford Arsenal and first loaded for use at the national matches at Camp Perry, Ohio, in 1924. It was propelled by a charge of HiVel powder at an instrumental velocity at 78 feet of 2,700 feet per second. The photographs were taken at a distance of forty-one feet from the muzzle of the gun.

Since the war the new boat-tail type of bullet has been extensively experimented with and used for national-match and other high-accuracy ammunition. It has not been adopted for general use in the military services up to the present time as it was first necessary to exhaust the supplies of Model 1906 ammunition left over from the World War. When the present supply of war-time ammunition has been used and it again becomes necessary to manufacture ammunition for general military use the new ammunition will, according to present plans, be of this type.



HOW THE BULLET WORKS THE CAMERA
It displaces the wire stretched across the ring in the center of picture thus breaking the circuit

Experiments conducted on the boat-tail type of bullet show that this shape for obvious reasons encounters less resistance in its passage through the air than the older type of bullet having a flat base. The boat-tail type of projectile entrains less air in its wake and if given the same initial velocity will have a greater extreme range and a greater remaining velocity at any point along its range than will the flat-base bullet.

The resistance offered to a flying bullet may be compared roughly with that offered to a ship moving through the water. The ship moves slowly through a dense medium while the bullet moves much more rapidly through a comparatively rare medium. However, the analogy cannot be forced too far due to the great difference in mobility of the two media and due also to the fact that while the movement of the boat is a simple two-plane movement, the movement of the bullet is in three planes, as in addition to the forward movement there is also a rotation impressed on it by the rifling in the rifle barrel from which it is fired.

The bullet used in these experiments was the same bullet that was submitted by the Frankford Arsenal in the Palma and International Ammunition tests held at Aberdeen Proving Ground, Maryland, in April of this year for the purpose of selecting the most accurate ammunition manufactured for the use of the United States teams in the Palma and International matches. The ammunition submitted by Frankford Arsenal, using the bullet here described, loaded to a velocity of 2,200 feet per second, broke the world's accuracy records at 300 meters range.

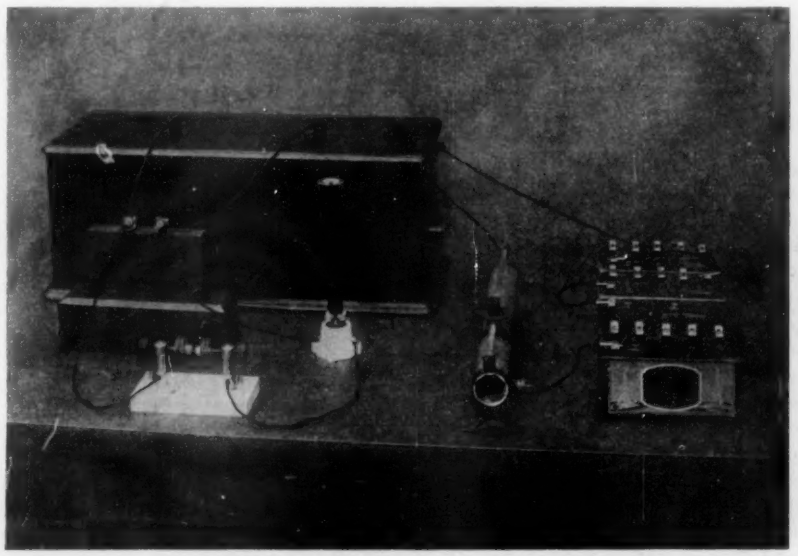
After the gun has been loaded and the photographic plate placed in position, the main electric switch on the control panel is closed and the current in the primary circuit is brought up slowly to a predetermined density by means of a rheostat. As soon as this density has been reached the adjustable relay operates, closing a little switch. This in turn acts on an electro-magnet in the firing solenoid (near the trigger, in the illustration), which discharges the gun.

Bullet Snaps Its Own Picture

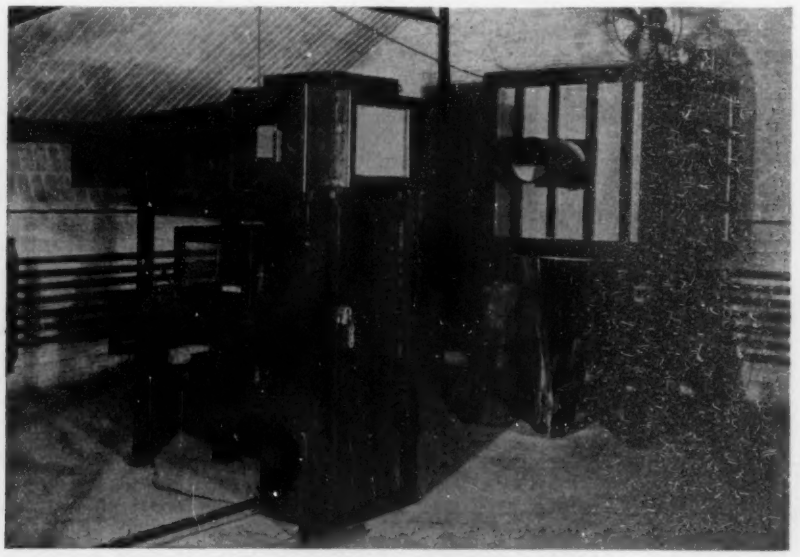
The bullet now passes through a long tube and encounters a two-inch piece of No. 20 gage, annealed, copper wire. This wire is held in place simply by friction and a light touch will dislodge it. When it is struck by the bullet it is thrown to one side. This breaks a current in the primary circuit of the apparatus. The sudden change of current in the primary circuit induces a high voltage within the secondary winding of the induction coil, which is essentially a 600 to 1 transformer. This induced high-potential current, passing through a series of resistances at capacities designed to damp out or eliminate extra sparks, eventually throws a single, one-way spark across the termini of an ordinary DeForest type of radio spark gap.

In our illustration the spark gap is included, for convenience, with the group containing the induction coil and batteries, but when taking a picture, this spark gap is placed in a light-proof box which also holds the plate; and when the plate is exposed by the bright and almost instantaneous spark, a shadowgraph of the bullet and the accompanying phenomena—air turbulence, etc.—is recorded on the photographic plate. This is, of course, not a photograph in the usual sense of that word, for no lens is used in the camera. Simply, the bullet casts a shadow on the plate. All, then, that remains to be done is to develop the plate and make a print by ordinary photographic methods.

The most ingenious point regarding this apparatus is the fact that after striking the wire, the bullet passes through a cardboard screen, in which a small hole has been previously cut for its free passage, and travels nearly two feet before it is photographed, thus allowing no stray air currents to modify the air phenomena accompanying the bullet. This effect was obtained by so designing the induction coil that approximately 1/1600 of a second elapsed between the breaking of the primary current and the jumping of the spark of the secondary circuit.



WHERE THE LIGHT COMES FROM
When the circuit is broken, a single, bright spark jumps the spark gap



TAKING A PICTURE WITHOUT A LENS
The camera contains two plates and the spark gap. The picture taken is a shadowgraph

The Theory of Stellar Evolution Modified

A Star's Life History Reinterpreted in the Light of New Knowledge

By Henry Norris Russell, Ph.D.
Professor of Astronomy at Princeton University
Research Associate, Mt. Wilson Observatory of the Carnegie Institution

THERE has been a good deal of discussion recently of the important problem of the evolution of the stars, and new results have been reached, which deserve mention in these columns.

It will be remembered that, until a year or so ago, the current theory of stellar evolution was one suggested originally by Sir Norman Lockyer, and revised later by the present writer. According to this theory a star starts as a huge mass of gas of low density, contracts, getting hotter steadily inside until it becomes so dense that the atoms of the gas, in the central regions, crowd one another, and no longer have room for unimpeded motion. This checks the rise of temperature, so that the star ceases to get hotter and finally cools off.

No Danger of Crowding

All this looked very good until last year, when Professor Eddington (as has been told in these columns) pointed out that in the intensely hot interior of a star, the outer parts of the atoms must be knocked off, so that the remaining residues are exceedingly small (probably about 1/100 the diameter of an ordinary atom) and that there is no danger of their crowding one another, even if the density of the mass as a whole is very great. We have told, too, more recently how Dr. Adams has proved the existence of the "Einstein shift" in the spectrum of the companion of Sirius, and found it so great that it appears that this little star, although of some 250,000 times the earth's mass, is only of about three times its diameter. This makes the mean density something like 50,000 times that of water, or almost a ton per cubic inch—and the density at the center must be considerably greater than the average—yet even here, the shattered fragments of the atoms must still be small enough to have plenty of room to move about.

Theory and observation, therefore, agree in showing that the idea that the history of a star is influenced by the close packing of atoms in its interior is quite untenable. What modifications does this conclusion demand in the conception of a star's life which, two years ago, seemed so satisfactory?

The question is a complex one, but, fortunately, many parts of it—although not all—can now be pretty definitely answered on general physical principles and observation of the stars themselves affords us a clue to the rest.

How One Science Promotes Another

A star is a huge isolated mass of matter, held together by its own gravitation, kept from collapsing by a very high internal temperature, and engaged in the business of generating heat in its interior, transferring it to its surface, and radiating it away into the inaccessible depths of space. Thanks to recent advances in atomic physics, we are now able to form a pretty detailed picture of the operation of all the processes involved.

The part played by gravitation, in producing an internal pressure in the star, is, of course, exactly calculable. The counter-pressure which holds this in equilibrium arises partly from the motion of the atoms and electrons of the stellar material, and partly from that of the imprisoned radiation from the hot matter, seeking ever to escape. The laws which govern these pressures are again precisely known and those which determine the degree to which the atoms are broken up into their constituent electrons are known closely enough for the present purpose. Two things more must be known before it becomes possible to work through the problem completely and find how the temperature and pressure vary from point to point inside the star, and how bright, and how hot on the surface, a star of given size and mass will be. These are the opacity of the material (which determines how fast the internal heat can escape toward the surface, and so how hot it can be kept) and the rate of generation of heat in the interior. The former has been carefully investigated by Eddington, Kramers, and others, and formulas have been derived which, although not vigorously proved, appear to be trustworthy. The latter, however, still evades us—probably because it involves properties of matter which are not accessible to our laboratory methods of experiment.

Absolute Magnitude Depends Upon Mass

With such knowledge as we already have, important steps may be taken toward a solution of the problem. The mathematical analysis proves so difficult (as is always the case in Nature's problems) that approximations are necessary, and there has been a rather lively reassuring discussion for months past between Eddington and Jeans as to the details of these.

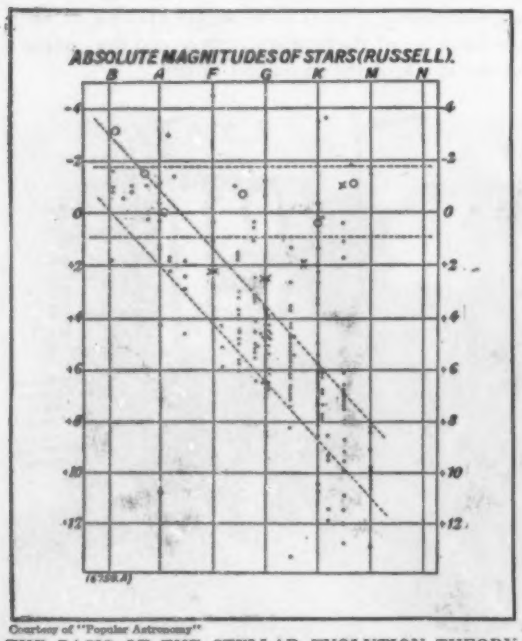
The general results, happily, may be explained without entering upon the arena of this mathematical combat. What we most desire to know is how the brightness or "absolute magnitude" of a star (to be exact, the total amount of heat which it radiates into space) and the temperature of its surface, will depend upon its mass and its diameter; and to these important questions the various approximations give fairly similar answers. It appears clear that the star's absolute magnitude must depend mainly upon its mass—the more massive stars being brighter—and very little upon its diameter (the various changes that accompany a change in size nearly compensating one another). Indeed, it is not quite certain whether if a star of fixed mass contracts, it will radiate more or less heat into space, although the most satisfactory approximations indicate that contraction causes a slow increase. The surface temperature, however, steadily increases as the size diminishes, and the central temperature must rise still faster.

Something More Is Needed

Just how bright and hot a star of given size and mass shall be depends, of course, on the law which governs the generation of internal heat. If this is almost all produced close to the center, and has a long way to leak out through the stellar material, the star when in a state of equilibrium, will not be as hot or bright as if the heat were produced near the surface.

But a recent paper of Eddington's calculating what would happen if all the heat were produced at the very center, shows that even there, the change would not be very great; and it appears, therefore, that we are already in possession of a good idea of how the brightness of stars of different masses and sizes should compare with one another, although we cannot calculate accurately from theory just how bright some particular one should be.

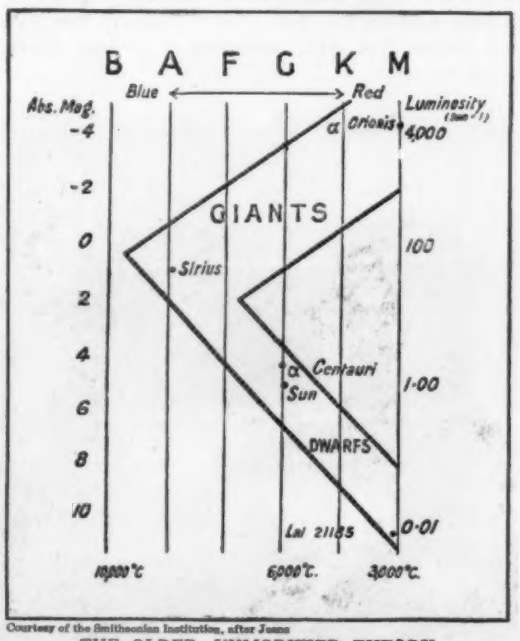
But all this new information, until something more is added to it, tells us surprisingly little about the history of a star. So far as this theory goes (as Jeans points out), it should be possible for a star of a given mass to have any absolute magnitude, or for a star of a given absolute magnitude to have any surface temperature. Yet the stars actually show very conspicuous relationships between these quantities, and it is on these relations that the previous theory of stellar evolution was mainly founded. Something more, then, is needed—but we shall have to wait to speak of it until next month.



Courtesy of "Popular Astronomy"

THE BASIS OF THE STELLAR EVOLUTION THEORY

If absolute magnitudes are plotted against spectral types, two series of stars are grouped, the Giants and Dwarfs



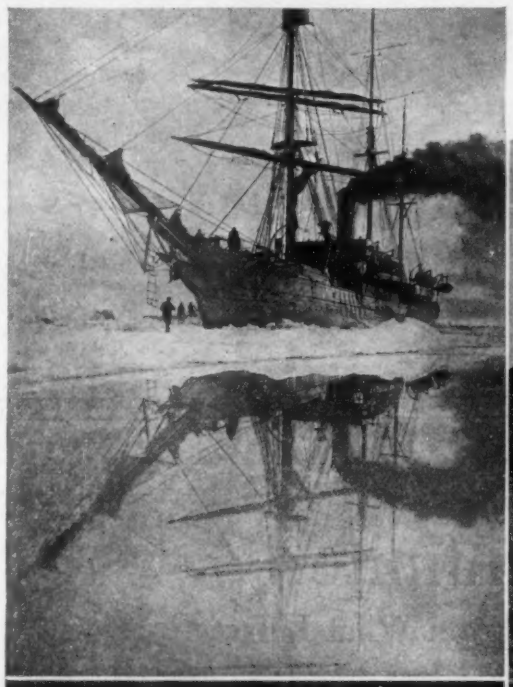
Courtesy of the Smithsonian Institution, after Jeans

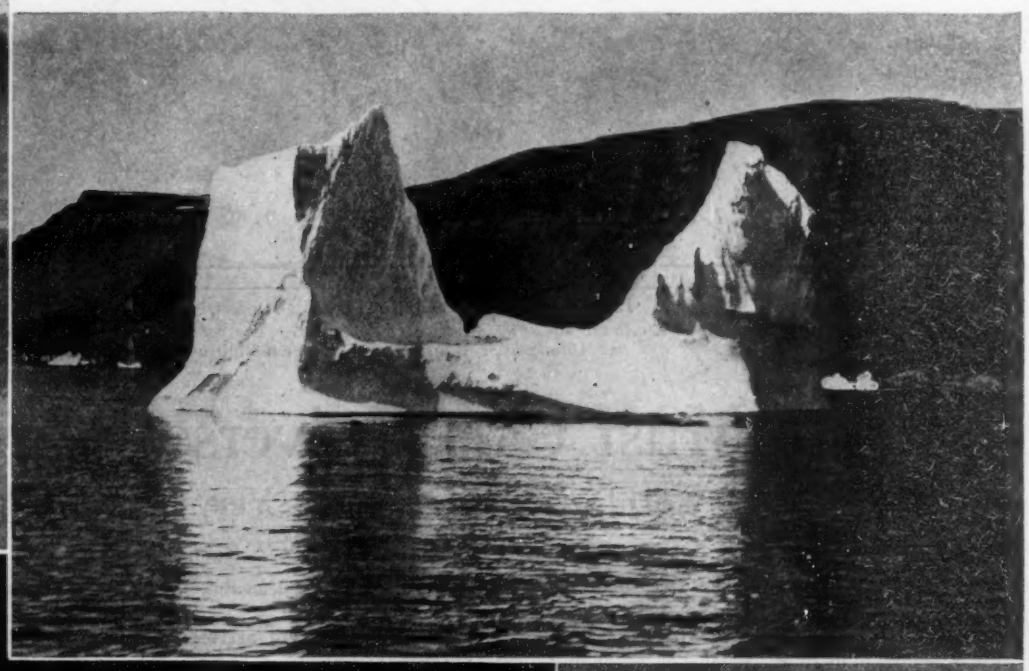
THE OLDER, UNMODIFIED THEORY

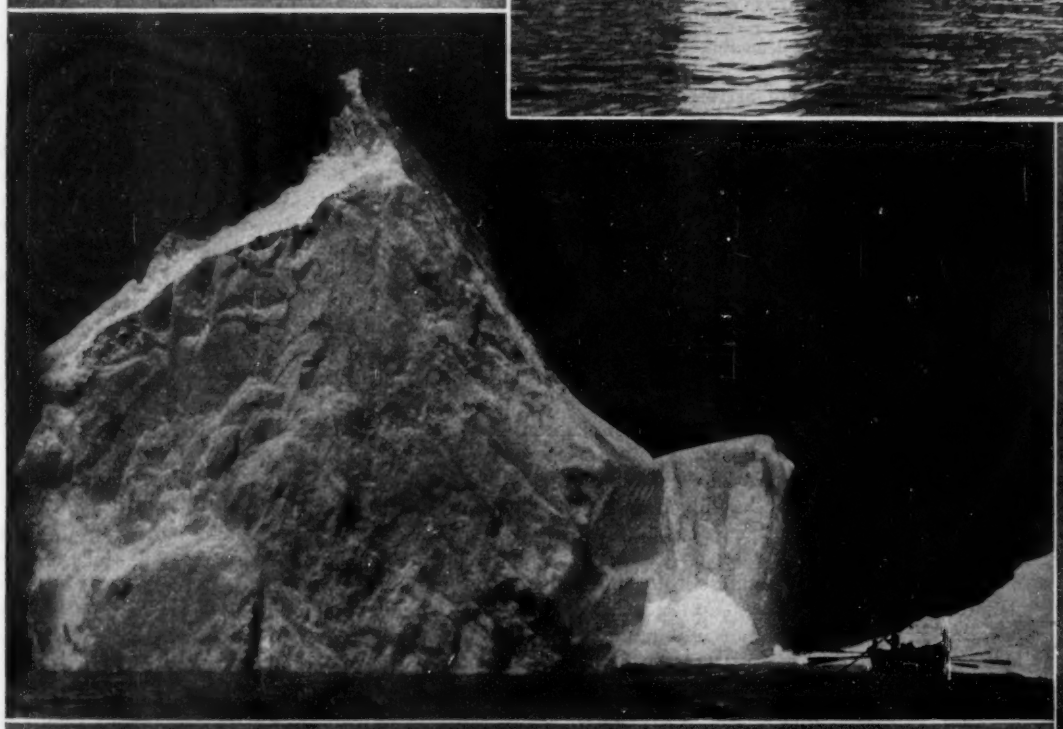
Giant stars grew hotter as they shrank. Reaching a critical temperature they again cooled as shrinkage continued

The Silent Menace of the Oceans

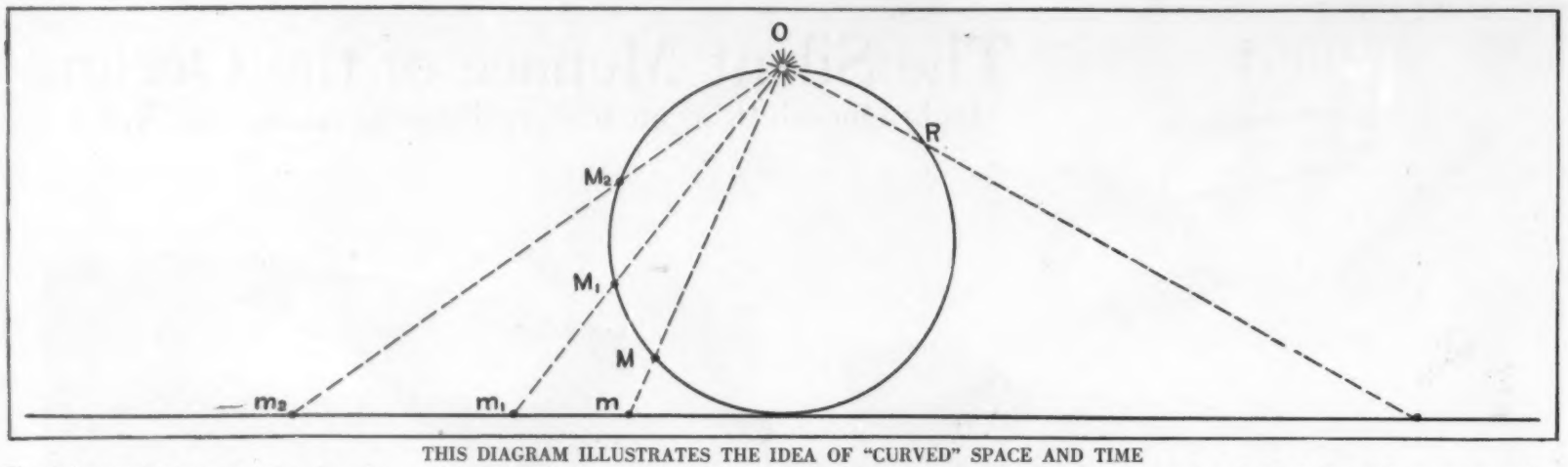
Only One-ninth of an Iceberg Projects Above the Water







In the upper left-hand corner the revenue cutter Bear *is shown caught in an ice floe in Behring Strait. It is one of the duties of the Coast Guard service to watch for icebergs and warn navigators. On the right is an iceberg off the coast of Greenland. In the center (left) we find a giant, photographed from the cutter* Tampa. *On the right is another iceberg found near the spot where the ill-fated* Titanic *went to her doom. The lower illustration shows another huge iceberg off the coast of Labrador. A towering mass of ice two or three hundred feet high and of immense bulk is an imposing, even if a rather fearsome, sight. It is little wonder that navigators dread them*



THIS DIAGRAM ILLUSTRATES THE IDEA OF "CURVED" SPACE AND TIME

The circle represents a cross-section of a sphere. At the top of this is a source of light, O. The point, M, as it moves around the sphere, casts a shadow indicated by m, m_1, m_2, and so on. Ultimately, it vanishes to infinity at the left and instantly reappears at the right

Must Our Universe Be Infinite?

The World May Appear to Us Very Different From What It Is

By Nicolas P. Rashevsky

Formerly of the Russian University at Kieff and of the Department for Russian Students at the University and Polytechnicum at Prague

AMONG the many unsolved problems presented to us by the science of astronomy there is one remarkable paradox. It is that the night sky is dark and star sprinkled instead of being as bright as noonday.

Consider the source of starlight. It comes from shining bodies, the stars, scattered through space at greater or lesser distances from the earth. In one region of the sky, that which we call the Milky Way, the stars are so thickly strewn that we see a dim but almost continuous luminosity, as though the whole sky were brilliant. In other parts of the sky the stars are scarcer. The luminosity is confined to single spots, each corresponding to an individual star.

Some two or three billion individual stars can be identified by the great telescopes. These do not cover the whole sky. Even with the greatest magnification and the longest exposure of the most sensitive photographic plates, the sky appears dotted over with individual stars instead of being uniformly bright.

Now, on the basis of our ordinary idea of an infinite universe more or less filled with stars, this lack of a full, uniform brightness of the sky is all wrong. Light decreases in intensity according to the square of one's distance from the luminous object. It never decreases entirely to zero. If the universe is infinite and if it contains an infinite number of stars, the amount of light reaching the earth should be infinite also. From individual stars at almost infinite distances the amount of light received would be almost infinitely small but this would be made up, on the average, by the fact that such distant stars would be almost infinitely numerous.

The Sky Should Not Be Dark

The sky ought, therefore, to be almost infinitely luminous. But it is not—it is dark. That is the astronomic paradox.

Escape from this paradox is possible, so far as light is concerned, by the assumption that light rays do not pass through empty space with entire freedom, but that they are very slightly absorbed. This is possible. There may be some very fine dust of some kind in space. The infinite amount of light which should reach us from an infinite number of infinitely distant stars may fail to arrive simply because it gets absorbed in space if but its journey be sufficiently long.

But this explanation, satisfactory enough for light, is not so helpful in explaining the very similar paradox which exists in the case of gravitation.

The force of gravitation, at least as it is observed inside our own solar system, decreases, as does light, according to the square of the distance separating the attractive bodies. The stars attract our earth just as the sun does. The only reason why the sun's attraction is stronger is that the sun is so much nearer.

And so, if the universe consists of an infinite number of stars scattered through an infinite space, the attraction of gravitation on the earth ought also to be infinite and alike from all directions. It is not. The equations which mathematicians, beginning with Sir Isaac Newton, have devised to express the laws of gravitation and the motions of the planets and their moons, require the assumption that the force of gravitation vanishes at an infinite distance, an assumption which is essentially equivalent (from our present viewpoint) to the idea that light is slightly absorbed in traversing long distances through space.

Of course, both these assumptions are possible. Perhaps light *is* absorbed in space. Maybe gravitation *does* vanish at great distances, obeying the customary law of variation with the square of the distance only when the distances are finite and small. But there is another possible explanation, one that is proving increasingly satisfactory to the scientists who are given to speculating about these matters. This is the idea that neither the number of stars nor the very universe itself need be considered as infinite.

In the first three articles of this series[1] it was demonstrated that our customary ideas of both space and time are exceedingly unreliable. Whatever be the real nature of the universe, it probably is some kind of blend of which "space" and "time," as we conceive them, are very partial and inexact aspects. Both space and time may vary from one part of the universe to another. These are the conceptions responsible for the ideas of "curved" space and "curved" time and of the "curvature of the world."

If we accept these ideas of world curvature (which were outlined in some detail in the preceding article) the paradoxes of gravitation and starlight bother us no longer. In a curved world, which is unlimited, but finite, the number of stars will be also finite.

Let us examine this more closely. Figure 1 is a cross-section of the sphere-and-plane idea of a universe, which idea was discussed and illustrated in the first article of this series. The sphere represents the reality. It is "curved." The plane underneath represents what seems to the observer to be real—it corresponds, perhaps, to our partial, inexact impressions of what the real universe is like.

To and From Infinity

Consider, now, a real point moving on the surface of the real sphere. At the top of the sphere, marked by the point O, there exists, you remember, a point of light.[2] As the real point M, moves on the sphere it casts a shadow, m, on the plane. For successive position of the point (marked M_1, M_2, etc.) the position of m moves farther and farther from the point of contact of the sphere on the plane, as is indicated by M_1 and M_2. When M reaches the source of light at the top of the sphere its shadow does a curious thing. It vanishes to infinity on one side of the plane and reappears, "from infinity," on the other side of the plane. This is illustrated by the shadow on the right-hand side of the drawing, when M has reached a point beyond the light source, say at R.

What has happened? In the "curved" universe of the sphere the point M has made a trip "around the universe." On the apparent universe of the plane this trip extended to, and returned from, what we call infinity. Accordingly, as was demonstrated in detail in the first article of this series, a finite number of points located on the surface of the sphere would appear (on the plane) to constitute a universe of infinite extent.

If our real universe has some such nature as this—some "curvature" of space-time, that is, which would give it properties similar to those of our imaginary

[1] "The Possibility of Other Kinds of Space," The Scientific American for November, 1924, pages 305-307; "Is Time the Fourth Dimension?" The Scientific American for December, 1924, pages 400-402; "The Size of the Universe," The Scientific American for January, 1925, pages 30-31.

[2] The reader is advised to refer to the drawing on page 307 of The Scientific American for November, 1924, and to the accompanying description on that page and on the two preceding pages.

sphere-and-plane universe—then a light ray starting off in any direction would make the trip "through infinity" and back again, returning ultimately to its starting point. Several writers have pointed out that such a return of light rays to their origins is one of the possible consequences of the theories of relativity and of curved space and time.

This return of light rays has never been observed experimentally. It is conceivable, indeed, that it is not observable by human resources, even if it be true. But suppose it had been observed. Would that prove that the universe is actually "curved," both in time and space, as some of the relativitists imagine it to be?

By no means. It is quite possible to imagine a way in which light rays might return to their origins in a universe which was both finite and uncurved; a universe consisting merely of an assemblage of a limited number of stars in a kind of space conforming entirely to our ordinary ideas.

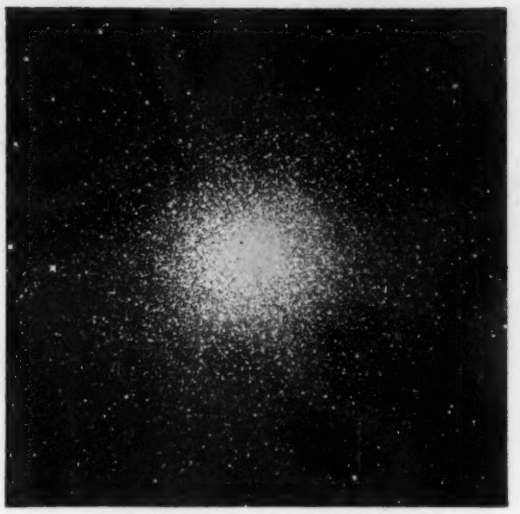
In such a group of stars the gravitational attraction of the whole group would be effective on each of the stars in the group. If any single star started to leave the group and fly off alone into space the attraction of the other stars would bring this wanderer back (assuming, of course, that its velocity was not above that certain critical value which would permit escape.)

A light ray would suffer the same fate. We know that light is affected by gravitation. Light has "weight." That was proved by the famous solar eclipse observations establishing the deflection of light rays that pass close to the sun. Accordingly, if a light ray started to escape from such a star cloud as we are imagining, it too would be brought back just as an escaping star would be.

Light Rays Like Elastic Cords

A homely illustration may make this clear. Boys play sometimes with small rubber balls fastened to elastic cords. A push to such a ball in one direction will not drive the ball entirely away. The elastic cord will bring the ball back. If the push is strong, the ball will return energetically enough so that it flies off in the opposite direction, as though it were trying now to escape by that path. Again the elastic brings it back. Thus the ball will oscillate a number of times on either side of the finger to which the other end of the elastic is attached.

This same kind of thing would happen to a star (or to a light ray) which tried to escape from the kind of star-cloud universe that we are considering. The gravitational attraction of the whole cloud of stars would bring the escaper back just as the elastic cord brings back the ball.



AT THE END OF THE UNIVERSE?

This is one of the distant star-clusters, many of which are visible in large telescopes. Some of these are the most distant objects yet discovered by astronomers

The faster the escaping star were moving, the farther it would go before it was forced to return. Light moves faster (we believe) than any star. Also the "weight" of light is small. For both reasons, therefore, light rays would go outward from the star cloud farther than anything else could go. Such a star-cloud universe would consist, in its central portion, of a lot of stars oscillating back and forth around a general center, like balls on rubber strings. Outside the star cloud proper there would be a shell of light rays, projected farther from the center than any star could be, but prevented, none the less, from complete escape. It would be as though the central star cloud were continually shooting out light rays with elastic strings on them. The rays could go a certain distance outward into space. Ultimately they must come back.

What would such a star-cloud universe look like to an observer inside it? It would look about like ours does. In all directions would be real stars. The number of them would be finite. The sky would be star-speckled, not fully bright. This is another way, then, to escape the paradoxes of light and gravitation with which we began this article.

Now, imagine an observer riding on one of the fast-moving stars that got out as far as possible toward empty space before its elastic string of gravitation forced it to return. How would the universe look to him?

It would look, surprisingly enough, just as it looked from well inside the star cloud. On the inward side, toward the great assemblage of the stars, these stars themselves would be visible. On the other side, outward toward "empty" space, the observer would see light rays returning from their outward excursions; being pulled back into the cloud by their elastic strings of gravitational attraction just as though they were stars themselves.

These returning light rays would make the observer think that he saw more stars out beyond the universe, just as he could see real stars by facing inward. It would seem to him, therefore, that he was still surrounded by stars in all directions.

And since light rays would always be able to go farther out into space than any star could go, no observer belonging to such a star-cloud universe could ever see around him anything radically different from what he saw when at the center of the cloud—or anything different, for that matter, from what we actually do see from our actual post of observation here on earth.

Two Universes Are Possible

There might exist, then, two entirely different kinds of universe, either of which explains well enough the return of a light ray to its origin, if that return is ever observed. One of these is the "curved-space" universe discussed in the preceding article. The other is the star-cloud universe just explained.

Either of these possible universes will fit, also, into everything that we observe on earth. Either will explain the paradoxes of light and of gravitation. Either is quite consistent with the actual appearance of our starry skies.

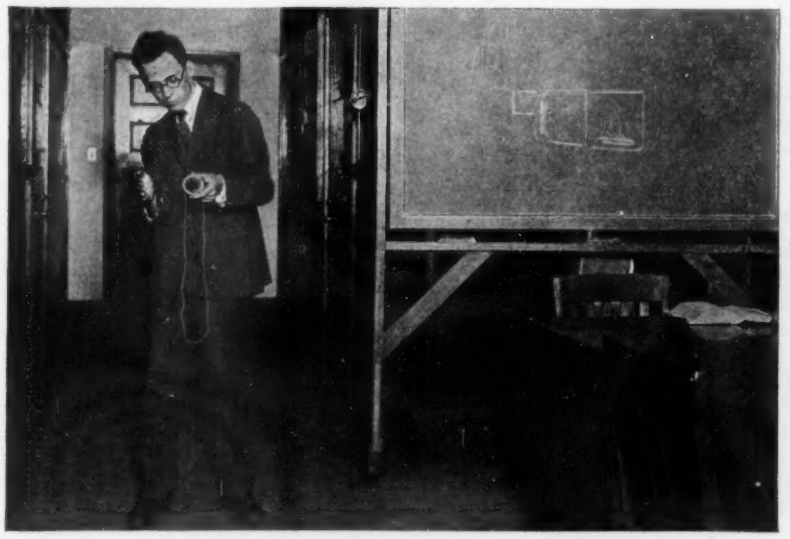
It is impossible that we distinguish, at present, which one of them is fact and which is merely imaginary. We come, then, to another limit of our knowledge. We cannot determine, from any facts now available to man, whether the space we live in is "curved" or not; whether our actual universe is finite or infinite. Its actual appearance is explainable, equally well, on either basis.

All of which but serves to show how limited, up to the present, is what we know of the real nature of that vast and marvelous something in which we live.

Separate Bits of Space

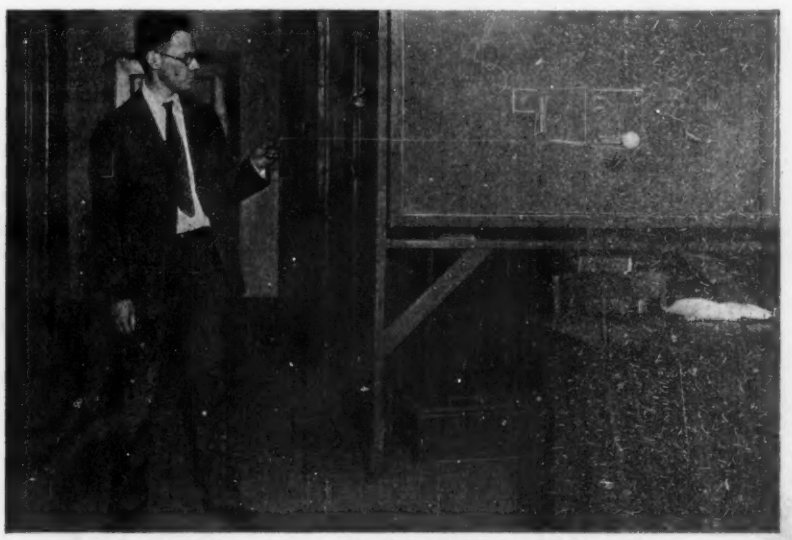
A stream of water seems to us continuous. It is all water. A rainstorm is discontinuous. It is composed of separate drops. Is space continuous, like the stream? Or is it discontinuous, like the rainstorm? Are there little separate fragments of space?

Dr. Rashevsky will discuss this question in the next article of this remarkable series which will appear in an early issue.



AN ILLUSTRATION OF HOW LIGHT RAYS MAY RETURN

The ball is attached to a rubber cord. When it is driven out sideways by the blow of the man's hand the rubber cord will bring it back



AT THE END OF ITS OUTWARD EXCURSION

Just as the ball will be pulled back presently, by its rubber cord, so outward rays of light may be brought back, Dr. Rashevsky suggests, to the universe

Wide World

Safeguarding the Airplane Pilot

Government Tests Determine How High Each Aviator May Safely Fly

By Boyden Sparks

GASTON TISSANDIER wished to put on his fur gloves for his hands were cold, but a strange torpor had seized him. The balloon was then 22,900 feet high, and Paris no longer visible.

"I now come to the fateful moments when we were overcome by the terrible action of reduced pressure," M. Tissandier wrote afterwards. "At this height I wrote, nevertheless, in my notebook almost mechanically, and reproduce literally the following words though I have no very clear recollection of writing them. 'My hands are frozen. I am well. We are rising. Crocé is panting. We breathe oxygen. Sivel shuts his eyes. Crocé also shuts his eyes.' At 24,600 feet the condition of torpor which overcomes one is extraordinary. Body and mind become feebler little by little, gradually and insensibly. There is no suffering. On the contrary, one feels an inward joy. There is no thought of the dangerous position; one rises and is glad to be rising. I wished to take hold of the oxygen tube, but found that I could not even move my arms. My mind was still clear, however, and I watched my aneroid with my eyes fixed on the needles. All at once I shut my eyes and fell down powerless and lost all further memory. It was about 1:30 P.M."

The balloon *Zenith* ascended to a height of 28,820 feet before it began to descend. When it returned to earth, Gaston Tissandier was still unconscious, but H. T. Sivel and J. E. Crocé-Spinelli were dead.

Those deaths occurred on a day in April, 1875, but there are today at Mitchel Flying Field on Long Island at the Army School of Aviation Medicine some pink and yellow rats (born white) whose lives are dedicated to the *post mortem* consideration of that aviation tragedy of half a century ago.

"We have apparatus at the School of Aviation Medicine," said Major Louis H. Bauer, head of this school, "which would have enabled us to have warned Crocé and Sivel that they could not hope to survive an ascension as high as they contemplated. A part of our equipment is a low-pressure chamber built like a bank vault in which we can reproduce and control the conditions of the atmosphere at an altitude of 40,000 feet, which is higher than *any* man dare go."

Air Medical Service Reduces Mortalities

Those pink and yellow rats are not an exaggeration. There are scores of them in galvanized wire cages at the School of Aviation Medicine, white rats really, but touched with aniline dye for purposes of identification.

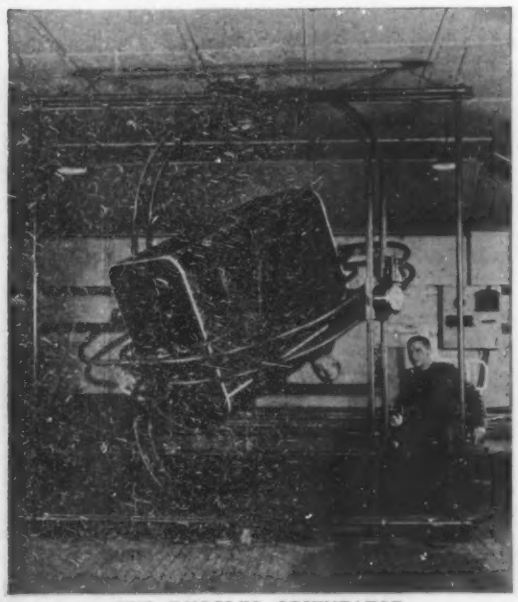
There is a small steel chamber with glass sides in one of the experimental rooms of this governmental medical college. The atmosphere in that chamber can be altered to suit the purposes of the experimenters and through the glass sides the antics of the rats may be observed.

Anyone who wishes to enter the army or postal flying service must pass a physical examination that is as rigid as the regular army examination.

The necessity for the special examination was shown early in the war. At the end of the first year of the struggle Great Britain balanced her books with respect to lost aviators and apportioned the causes as being due, two percent to Germans; eight percent to defective planes; and ninety percent to the pilots. Then they established an Air Medical Service, with the result that during the second year fatalities due to physical defects of the pilots fell to twenty percent, and during the third year to twelve percent. Similarly, the coming of the flight surgeon reduced the mortality of flying in the American service.

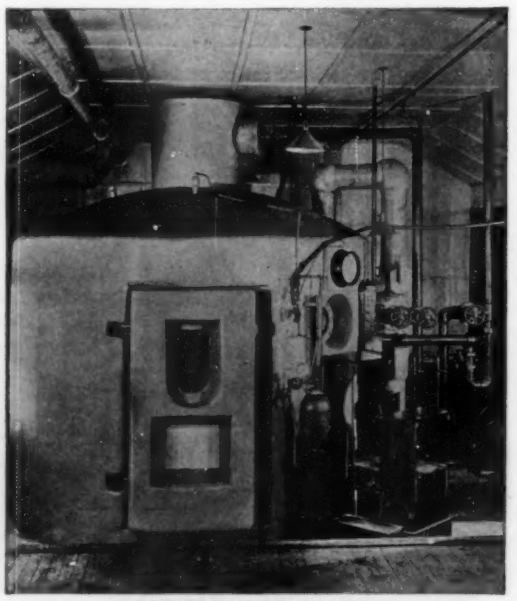
I asked Major Bauer why aviation should demand higher physical attainments than any other branch of the service.

"When an aviator leaves the ground," he replied, "he is in an entirely new and unnatural environment.



THE RUGGLES ORIENTATOR

The would-be pilot is whirled in this universal-movement machine to test his sense of equilibrium



A LOW-PRESSURE CHAMBER

In this chamber an aspirant for aviation training is subjected to every discomfort of high altitudes

He must be on the alert every moment. He needs literally to see on all sides at once. He must have a keen sense of motion, as his equilibrium is constantly disturbed.

"If he is flying in the dark or in clouds, his ability to detect change of level cannot depend on his vision because he cannot see. He must look now at the horizon, now back at his instrument board with its delicate gages, now off into the distance, looking where there may be nothing tangible to see, but looking nevertheless, for his life may depend on his seeing. That shift from the instrument-board reading to the gaze at the horizon, we call accommodation. Many persons' eyes will not respond for any length of time to such strains."

Keen Sense of Equilibrium Necessary

There is an apparatus at the School of Aviation Medicine known as a Henderson re-breather, in which men sometimes are temporarily transformed into irresponsible beings. It includes a white-enameled iron chair, in the rear of which is a tank containing all of the air that the subject who sits in the chair is going to breathe during the test. Rubber tubing connects the reservoir of air to the subject's mouth. His nose is clamped shut so that he may not breathe the air of the room. In front of him there are two rows of tiny electric light bulbs on the surface of a desk, and two rows of brass screws with semi-spherical heads in brass washers. For each light bulb there is a corresponding brass screw. Underneath the desk is a pedal that suggests the treadle of an old-fashioned organ. This, properly operated, is capable of altering the speed of a small electric motor attached to the end of the desk. The desk is known as a Dunlap psychological apparatus.

Four people give the test, one to watch the subject; one to take his blood pressure and pulse at frequent intervals during the twenty-five minutes it persists; a third to act as psychologist, and a fourth to operate the machine. In the re-breathing apparatus the subject breathes the same air over and over again, with the carbon dioxide eliminated. Gradually he burns up the oxygen, and as he does so he experiences almost precisely the same discomfort he would feel at a high altitude.

From the start, lights are flashed here and there along the top of the desk. As each light comes on, the man in the chair is expected to touch the corresponding brass screw head, not in a slovenly manner and not on the washer.

For the first five or ten minutes he does splendidly; then perhaps his attention flags. As the test proceeds, some men forget to pay any attention whatever to the flashing lights, and others are as awkward as babies reaching for some strange object. Some giggle hysterically, and then, to some, there comes a point when, if the test was not interrupted by the watchful quartet in charge, the subject would faint.

AND THEN THE EYES

The vision of army aviators is tested at frequent intervals. Nerve strain of flying reveals itself at an early period in defective vision

The subjects who are given this test never realize that their actions, as the test progresses, are anything but normal, and neither does the aviator realize the subtle and baleful effect of the lowered oxygen pressure until it is too late.

Flyers are graded "A," "B," and "C," according to their ability to withstand the lowered oxygen pressure of the higher altitudes. The "A" men are unrestricted as to height; "B" flyers are cautioned that they are so constituted as to be unlikely to fly efficiently above an altitude of 15,000; "C" flyers are warned that for them the universe is limited to a narrow margin only eight thousand feet wide.

"The majority of aviators are partially deaf," Major Bauer told me. "Experience has shown that continued exposure to high-powered motors lessens the acuteness of man's hearing. To conserve their hearing most aviators are careful to shield their ears, and for this purpose we have found nothing better than securing a lady's powder puff over each ear. But there is another important phase of flying to be considered in connection with the ear. That is equilibrium.

"This is not strictly an ear problem, but the ear plays a large part in it. The aviator may desire to keep his plane flying on the level or he may have to turn upside down, twist around in a quick spiral or spin in which his position is altered rapidly with respect to the horizon. If this happens, he must not become confused, but must be able to interpret his sensations accurately. Vision may be obliterated, of course, by clouds and darkness. What has the aviator to depend on then?

"There is his tactile sense. Here is something that we have thus far found difficult to test. But we can test the ear's role in equilibrium by means of the Barany chair in which the subject is whirled this way and that, and then required to point his finger at some previously designated spot."

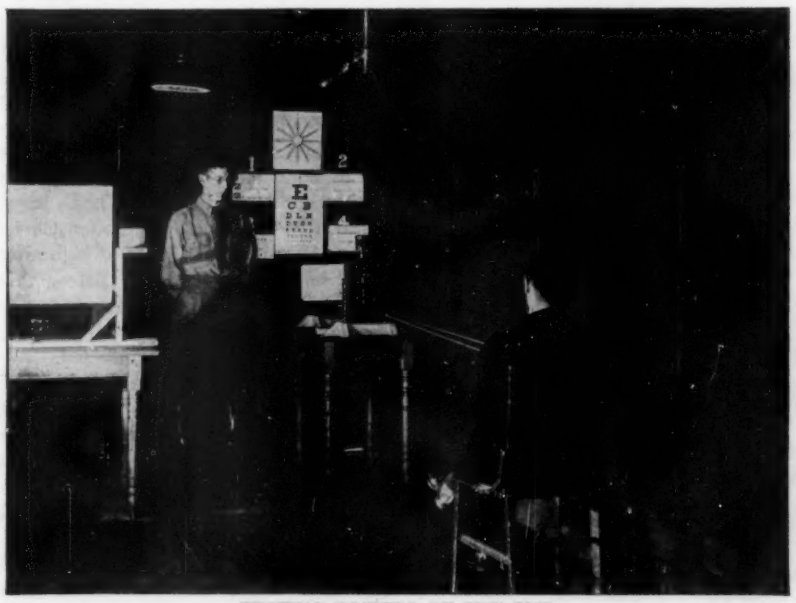
Temperament Plays an Important Part

There is an extraordinarily elaborate equipment for testing the powers of the eye at the School of Aviation Medicine, and not only applicants for admission to the air service, but the veteran flyers are called in for frequent examinations of their eyes.

"We notice a falling off in visual acuteness after a man has been flying a while," said Major Bauer. "The flight surgeon out on the field will observe that a flyer is beginning to make poor landings. Then we look that man over. Sometimes he merely needs a rest from flying, and is temporarily removed from flying duty. Sometimes the trouble seems to be of a more permanent character, and the flyer is grounded permanently.

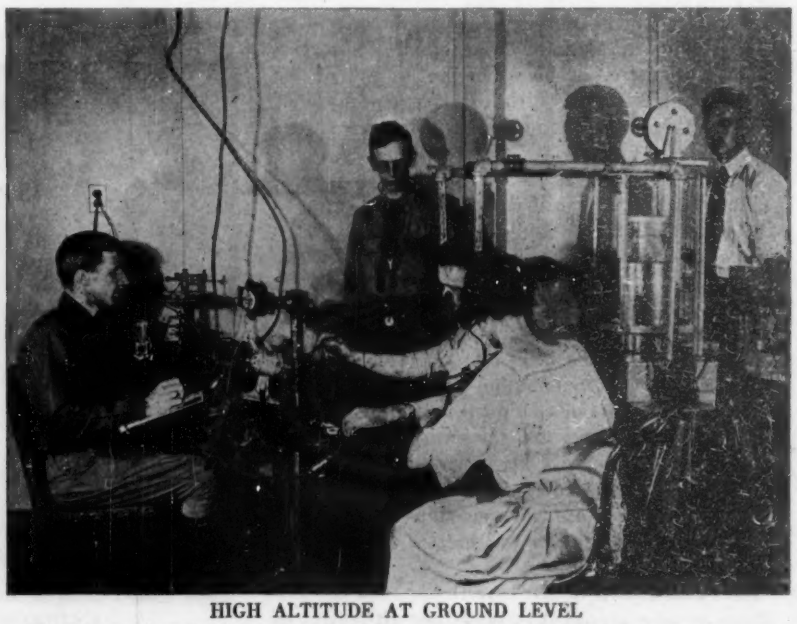
The flight surgeon must know his men as the college coach knows his football players. They need handling, and it is his job to see that they get it, each according to his temperament. The flight surgeon has a better opportunity to study his charges' dispositions than even the wives or mothers of those men.

The normal man, the average man, could probably pass the army examination and become a flyer, a pilot, and as for being a passenger, almost anybody can be a passenger. The air passengers of the future need worry only about one thing—has the pilot been looked over by the flight surgeon?



TESTING POWERS OF THE EYE

The extraordinarily elaborate equipment used for testing the vision of applicants for the air service



HIGH ALTITUDE AT GROUND LEVEL

Henderson re-breather for testing the ability to withstand the lowered oxygen pressure of high altitudes

The Higher Education of the Silkworm

By Philip N. Youtz

Photographs through the courtesy of Canton Christian College.

CHINA taught the West the secret of the ancient silk industry fourteen centuries ago. Today, the West is teaching China how to produce silk scientifically.

In Canton stands a modern college, a living memorial to the traditional friendship between America, "the country of the star spangled banner," and China, "the country at the center of the universe." Beneath its green-tiled roofs a joint faculty of Americans, British, and Chinese are working for a cultural reciprocity between the East and the West. Not a foreign institution, built on Chinese soil by foreigners' charity, but a coöperative undertaking receiving more than two-thirds of its support from Chinese, and administered by a distinguished group of Chinese scholars and foreign scientists. Because of its non-denominational character and its Chinese support, the Silk Association of America chose the Canton Christian College as one of the strategic points from which to start the study of sericulture from a scientific point of view.

A New Race of Super-worms

The broad three hundred and fifty acre campus of the college offered ample space for raising the mulberry leaf, the exclusive diet of the silkworm, and the head of the College Department of Biology already had made the acquaintance of the life history of numerous silkworms in his laboratory.

The members of the Silk Association of America, through voluntary contributions, donated a special silk building, a sort of combined foundling hospital and sanitarium for worms. Here the anaemic silkworm could be X-rayed by powerful microscopes, and all his many disorders diagnosed and corrected. To accommodate those who acted as "interns" at this hospital, a dormitory was erected near the silk building.

The Chinese staff of the new Department of Sericulture at once prepared to delve out all secrets of rearing worms which had been handed down among the Chinese farmers from father to son for hundreds of generations. The foreign entomologist, a member of the American staff, scoured South China, and even sent to North China, Japan, and India, for the largest and finest worms to be found in order to have worthy ancestors for a new race of super-worms.

Numerous autopsies on deceased members of the silk worm tribe revealed that from fifty to a hundred percent of the worms raised in South China were infected with diseases that made the infant mortality rate excessively high and destroyed the value of the silk from those hardy enough to survive. The elimination of these diseases would enable South China to produce four or five times as much silk.

The silkworm's sickly constitution was found to be due chiefly to three diseases: *muscadine*, prevalent in hot, humid weather, but easily controlled by proper ventilation; *flacherie*, a sort of acute indigestion caused by careless diet; and *pebrine*, caused by a protozoan parasite of the intestines. The first two diseases were easy to eliminate.

A CHINESE MERCHANT

Selling mulberry seedlings at a market in South China

The *pebrine* was more difficult. Experiments conducted by the French scientist, Louis Pasteur, had shown that the spores of *pebrine* entered the eggs of the young worm from the mother, and the disease was therefore inherited. He also demonstrated that by grinding up the mother moth after she had laid her eggs and examining her remains under a microscope, the spores of the disease could be detected.

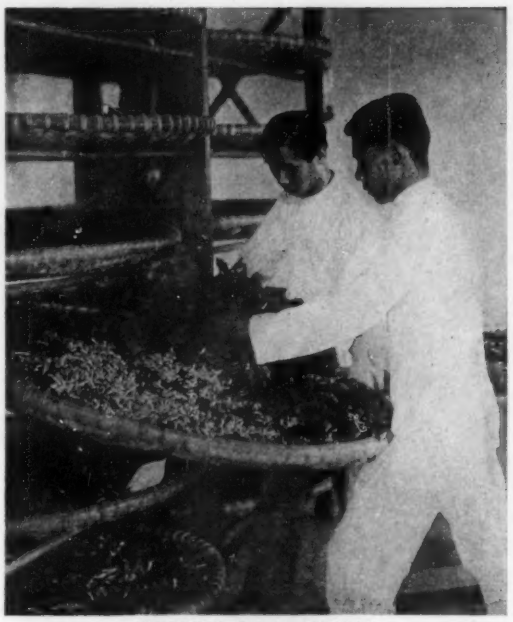
Accordingly, in the silk laboratory, the moths were isolated under small cones. Eggs from diseased moths were destroyed and only those from healthy mothers retained. In this way the disease was reduced to less than one half of one percent.

Like Babies, They Just Eat and Sleep

The Chinese farmers buy silkworm eggs in the spring. These are very minute and are sold on sheets of stiff paper containing 200,000 to 240,000 eggs a sheet. It is just as important that silkworm eggs be fresh and in good condition as it is for hen's eggs. The new Department of Sericulture at Canton Christian College began its practical work by distributing disease-free egg sheets to the farmers. Before this time the eggs on the local market were commonly so poor that rarely more than eighty percent hatched, and over ninety percent of those were infected.

The first season overcame the Chinese farmers' distrust of college eggs. As soon as they found that all of their worms hatched and that they spun much larger cocoons than the local product, the demand became greater than the supply. The college then adopted the practise of selling chiefly to professional egg dealers. These men procured their egg sheets, which they sold on the market, from the disease-free, selected stock of the college. Thus the distribution of healthy stock was multiplied a thousand fold.

After the farmer purchases his egg sheets, he



FEEDING THE HUNGRY
"Interns" feeding silk worms at the silk laboratory

places them in a clean basket in a small rearing room in his house. Charcoal fires in earthenware braziers are used to keep the temperature at eighty degrees day and night for nine days. Then the eggs turn green. A day or two after this the worms hatch.

Usually this occurs between four and nine o'clock in the morning. The newly hatched worms are so small that the Chinese call them "ants." Fresh, soft mulberry leaves are shredded very fine and sprinkled over the "ants." Their jaws are too weak to chew much of the leaf, but they can suck out the juices.

For the first two or three days the young worms must be fed every two hours night and day. By this time the worms have eaten so much that a change of skin is necessary. For twenty-four hours the worms sleep, during which time the old skin is lost. The life of the silkworm is divided into five periods. In each of these there is a day or two of gluttonous feeding followed by a drunken sleep while a skin one size larger takes the place of the outgrown one.

The worms reach their full growth in eighteen days. Some idea of their ravenous appetite can be gained from the fact that a group of 200,000 (the number hatched from one egg sheet about one foot square) eat a ton and a half of mulberry in a little over a fortnight. During this time they grow from the size of a speck to about three inches long.

On the eighteenth day the worms begin to "ripen." They wave their heads around restlessly. Their color changes from blue-grey to a translucent yellow. Seeing these symptoms, the farmers transfer the worms to a bamboo rack. Almost immediately they begin to spin their cocoons, which takes them about twenty-four hours. The cocoons are held over a charcoal fire to stifle the larvæ, and thus prevent their piercing the cocoon, which would make it valueless for reeling purposes. They are then ready to be sold to filatures where they are unwound and reeled.

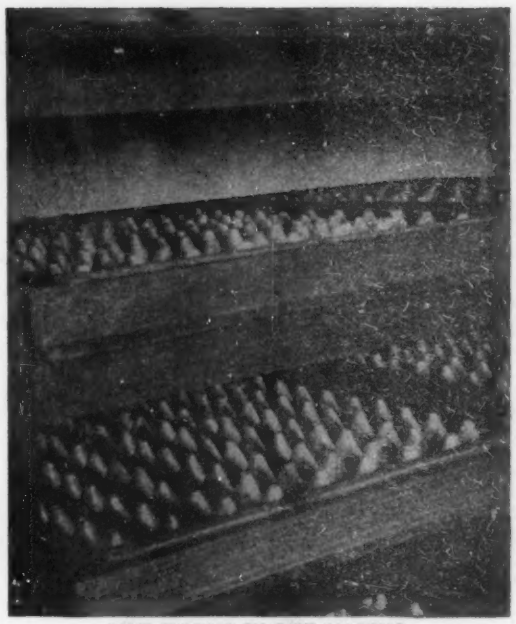
The climate in South China is nearly ideal for sericulture. From the end of February to the first of October, in a good season, it is possible to raise as many as seven crops of worms. On an average, each generation requires thirty-four days.

Though the silk produced in South China is of a particularly soft and lustrous texture, the quality in recent years has not been up to grade. This is due, not only to the obsolete methods of rearing the silkworms, but also carelessness at the filatures. The Department of Sericulture, founded by the Silk Association of America at Canton Christian College, has been so successful in conquering the diseases of the silkworm and in producing better cocoons, that the Association has now undertaken the task of improving the filatures where the silk is unwound. For this purpose a new reeling laboratory is now being built. This new building will contain the newest type of machinery for reeling the silk from the cocoons, a cold storage plant for preserving the eggs from one season to the next, a power plant, class rooms, and laboratories for testing silk.

Eight Cobwebby Strands Make One Thread

At the filature the cocoons are placed in bowls of hot water. This softens the gum which the silkworm secretes to make the strands of silk cohere when forming the cocoon. On the outside is a soft fluffy mass which is removed as waste. The threads from eight or more of the cocoons in the bowls of hot water are passed through a small hole in a smooth piece of glass and thence to a wooden reel. The strands of silk from the cocoons are as fine as cobwebs, so they can scarcely be seen in the steamy atmosphere of the filature, but after the eight are joined together by passing through the glass button, they make a thread that is easily visible. There is enough natural gum left on them so that they readily adhere to each other, forming one thread.

When the useful fiber of an individual cocoon is completely unwound, a new thread must be thrown in. In China this is done with chop sticks and is a delicate process. If several cocoons become exhausted at once, and new ones are not thrown in immediately, then a thin spot results in the thread which will break when the silk is put into the high-power weaving machines. Constant watchfulness is necessary on the part of the women workers. If the water in the basins is not the right temperature, winding is irregular, and if fresh water is not put in frequently, it becomes dirty, and particles of dirt and bits of silk stick to the thread and cause defects.



SILK WORMS IN THE MAKING
Egg-laying silk moths isolated under small cones

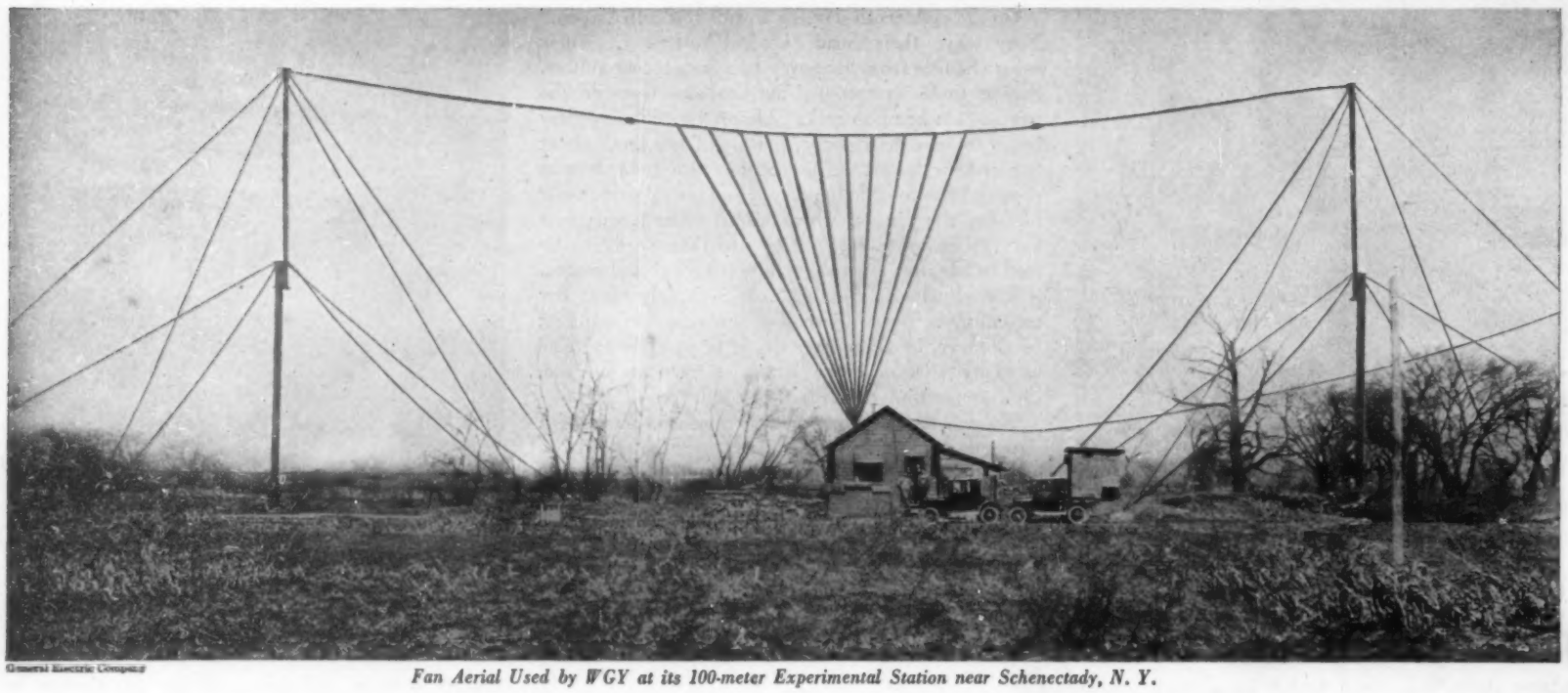
After the reel is full of silk it is removed and taken to a special room where it is rewound onto a reel of the size and manner most usable in American silk factories. This is called "rereeling." In this operation many defects and spots can be removed. What is left of the cocoon is classified as waste silk and is also sent to America where it is subjected to refining processes, through which we secure the shorter fibres for spun silk.

After rereeling, the skeins of silk are weighed, twisted, and packed into bundles of thirty skeins, called a "book," and ten of these, after being wrapped in a cloth, go into a bale.

Each skein of silk weighs about two Chinese ounces (2.06 ounces). To produce one skein from four to five catties (5.2 to 6.5 pounds) of good quality dry cocoons are required. One catty (1⅓ pounds) contains about 1,000 cocoons. So, to produce one skein of silk about 5,200 to 6,500 cocoons have been used.

SEPARATING THE DISEASED FROM THE HEALTHY
Prof. C. W. Howard, head of the Sericulture Department, at the left

SELECTING THE MATURED WORMS
Picking out "ripe" silk worms, that is, worms which are ready to spin their cocoons



General Electric Company

Fan Aerial Used by WGY at its 100-meter Experimental Station near Schenectady, N. Y.

Will Your Radio Set Be Obsolete?

Research Laboratories, the Navy, and Amateurs Are Experimenting and Discovering Numerous Advantages to be Obtained by the Use of Short Wavelengths

By Orrin E. Dunlap, Jr.

CURRENT reports, caused by a sharp decline in radio stocks and bargain sales of receiving sets during the summer, have spread the impression that a revolutionary change is destined to come this winter, which will make obsolete every broadcast receiver in use today. A survey of facts shows that such rumors are not well founded as far as this year is concerned, but the natural course of events may make it true within five years.

There are certain to be numerous changes in the art of broadcasting and listening-in. Most of the improvements will come gradually and they are likely to work up to a point within five years when every broadcast listener tuning with a set he bought in 1925, will realize his apparatus is completely out-of-date. The impending change in broadcasting can not be effected over night or within a year, because there is too much involved for a sudden scrapping of all equipment. It is possible for it to evolve only over a period of years.

Ether Congestion Constantly Increasing

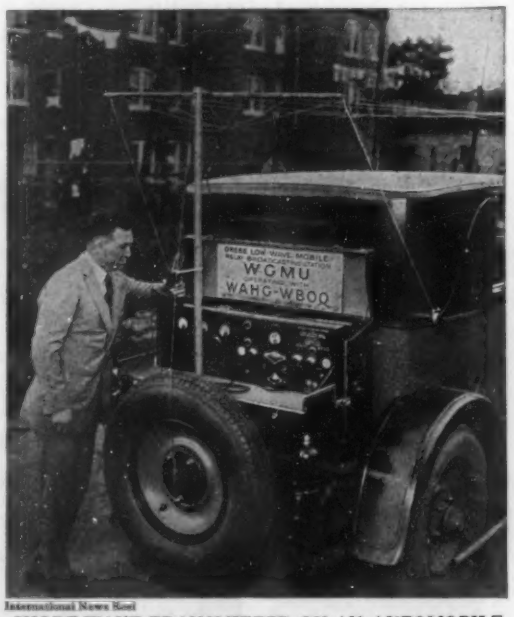
Some believe a radical change is imminent because the ether is so congested that there are no channels left for new stations. Months of experimenting has revealed that there are no paths in the ether through which another carrier wave of a Class B station can be pushed, unless the broadcasting wavelength band is broadened. So scarce are wavelengths that one New York station manager made the following statement:

"Our ether channel is worth more than a seat on the stock exchange."

Leaders in the field of broadcasting predicted and expected that the beginning of 1925 would find only 400 stations and that this number would be gradually reduced to about 75 high-power transmitters. This ideal condition was not forthcoming and instead the number of broadcasters is hovering around 570, and more and more new stations are making their appearance in the ether each week. It is understood that 150 applications for licenses are waiting wavelength assignments in Washington.

There seems to be no doubt that the popularity of the ether will continue to increase. Broadcasting is comparatively young, yet the available space is already saturated. Necessity being the mother of invention some plan is sure to come which will create more room in the air. One solution is apparent.

The trend today indicates that some day radio entertainment will be heard on extremely low wavelengths, below 80 meters. If such a plan would be put into effect tomorrow, new apparatus of a simpler nature, smaller coils and condensers of the low-loss type, short wires and a much shorter antenna would be needed.



International News Reel

SHORT-WAVE TRANSMITTER ON AN AUTOMOBILE

This 63-meter, portable broadcaster goes to the scene of the event to be broadcast and relays it to the main station, WAHG, for re-broadcasting on 316 meters. The low waves take the place of land wires

But why are short waves a solution to the congestion? Engineers explain that many more stations can use the air if short wavelengths are employed, because short-wave channels can be placed closer together without interfering with each other.

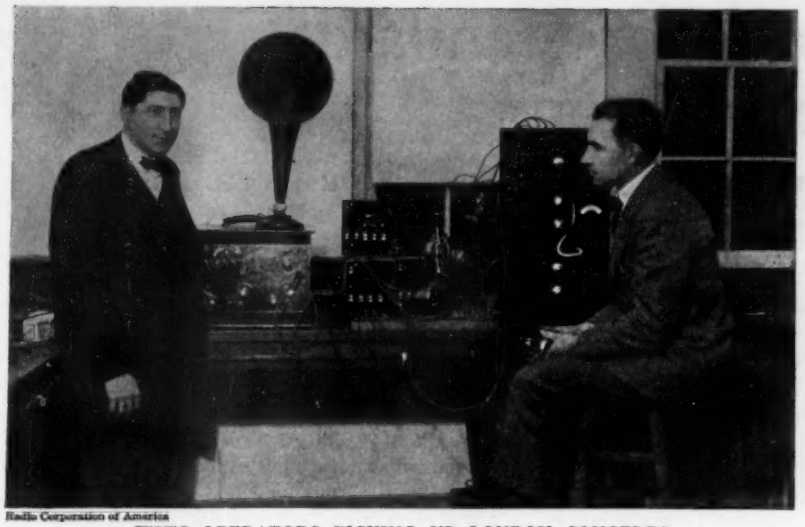
Use of Short Waves the Solution

Secretary Hoover in seeking a solution for his most perplexing problem—that of more broadcasting channels—turns not to large experimental laboratories or to professional radio experts, but to the 18,000 amateurs of the country. In doing this Mr. Hoover recently authorized the amateurs to use waves less than one meter in length in addition to their previous assignment. The permission covers the channels between .7477 and .7496 of a meter; in other words a band at about the three-quarter-meter wavelength. Few people realize the immense number of possible operating channels that lie in the low wavelengths. Although the band now assigned to amateurs is only nineteen one-thousandths of one meter in width, its extremes are separated by 1,000 kilocycles.

Secretary Hoover has called attention to the fact that if it ever becomes feasible to conduct broadcasting on these frequencies, it will be possible to place within this band 100 broadcasting stations and give to each the present separation of ten kilocycles. He further pointed out that all the radiophone stations in the world could operate in the upper half of the one-meter band.

"The art has, of course, not developed to make this possible," Mr. Hoover concluded, "but the amateurs now have an opportunity to see what they can do."

There seems to be little question that short waves will supplant the high wavelengths now used for



Radio Corporation of America

WJZ'S OPERATORS PICKING UP LONDON CONCERTS

Programs from England sent across the sea on 1600 meters are received at Belfast, Maine, and relayed to New York on short wavelengths, where they are rebroadcast on waves within tuning range of the ordinary listener

Radio Corporation of America

SHORT WAVES RELAY THE STORY OF INTERCOLLEGIATE RACES

A low-wave transmitter on board a motor boat following in the wake of the college shells on the Hudson at Poughkeepsie forwarded the description of the race to WJZ, atop Aeolian Hall, for rebroadcasting on 455 meters

transoceanic commercial traffic. POZ, the big station at Nauen, Germany, is working with South America on 30 meters and 10 kilowatts and obtains the same results that formerly required 400 kilowatts on the 12,600-meter wave.

Before the low-wave band can be used for broadcasting several problems must be solved. Listeners in Europe report that the 63-meter signals of KDKA, Pittsburgh, with 10 kilowatts, certainly get across the sea, but the big drawback is a rapid fading or wavering which causes distortion. Engineers blame this on the Heaviside layer, a mirror-like medium, believed to exist about 60 miles above the earth. This layer seems to act similarly to a looking glass, reflecting the Hertzian waves back to the earth. Its reflecting ability varies, possibly because of the sun's rays and the changing conditions of the atmosphere, just as a mirror reflects differently when a person breathes upon it. The wavering increases as the wavelength is reduced. The effect is not the same on all wavelengths and it differs at receiving points, although they may be only a short distance apart.

To overcome this an experimenter at Stuttgart, Germany, suggests that three different receiving stations be connected together by land wires. This system irons out the fading, because when the signals fade at one station they are generally steady at the others. He found that this helped in receiving KDKA.

"Jump-over" Effect Must Be Overcome

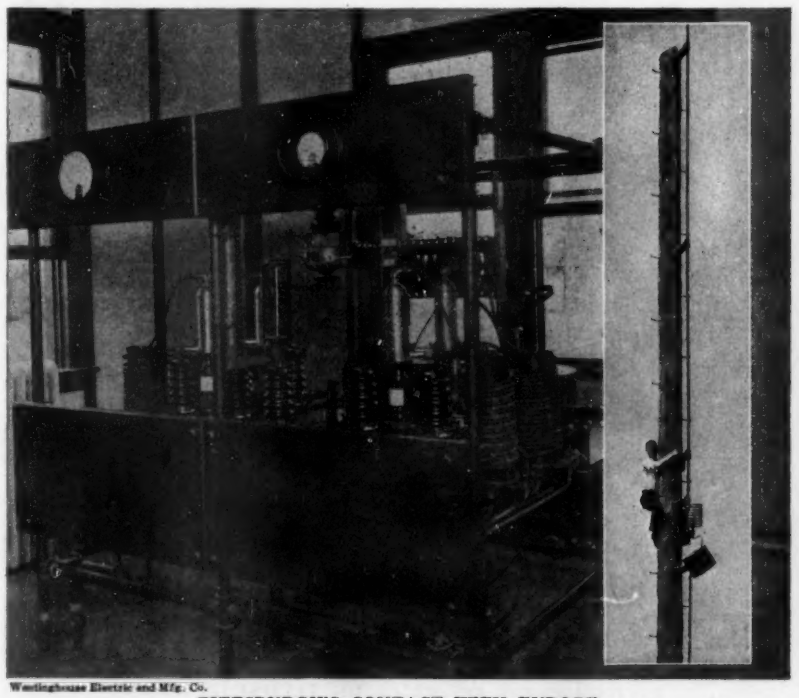
Another difficulty of the short-wave receiver is its extremely critical characteristics. The aerial must not swing in the wind or the set will be detuned. A metal pencil placed on a table near the receiver if touched by the hand has been known to detune the circuit completely. This is chiefly because short-wave reception depends absolutely upon regeneration. Radio-frequency amplification seems to have no advantage on a short-wave set.

A German listener reports that he hears the harmonics of WGY, especially on 76 meters, and WBZ on 55 meters, when there is absolutely no trace of their 380 and 333-meter main waves.

There is a peculiar "jump-over" effect noticed in short-wave transmission. The signals may be inaudible up to 500 or 1,000 miles but will be as strong as a local station outside of that radius. One explanation offered for this is that the waves shoot right up to the Heaviside layer and are not audible until reflected back to the earth's surface. This is another problem engineers are striving to solve. KDKA's 63-meter wave is no louder in Cleveland than the 309-meter signals, but in Europe the 63-meter wave is at times as loud as a local station, while the 309-meter channel is inaudible.

If manufacturers see the trend of development in the low-wave direction, they will gradually begin to design their sets to be more flexible in regard to wavelength bands. One manufacturer has evidently sensed the change, because he recently placed a five-tube receiver on the market with interchangeable coils, designed to tune-in from 40 to 555 meters. The coils of various sizes are provided with bases similar to vacuum tubes and they fit into sockets thus facilitating a quick change.

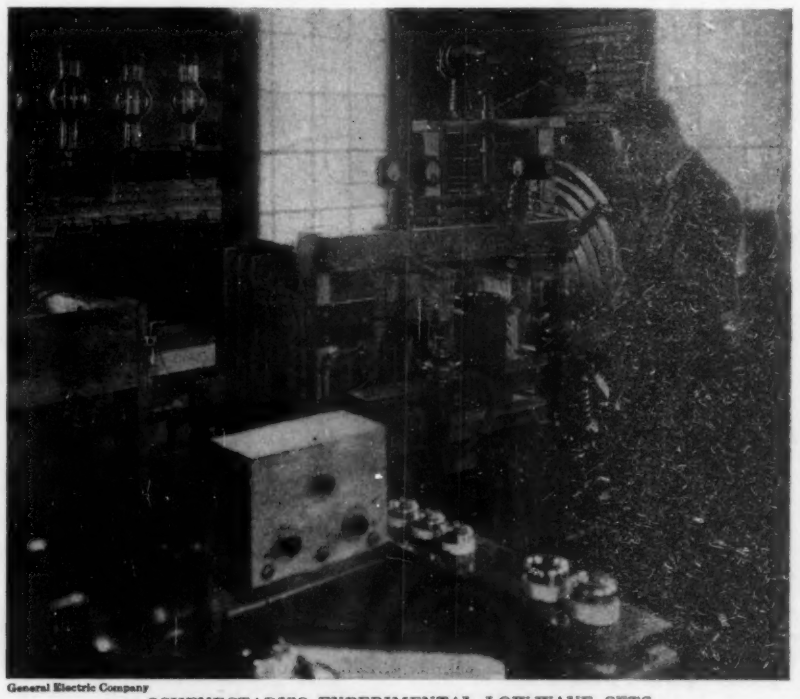
Stations KDKA, WGY, WLW and WBOQ are taking advantage of the extraordinary qualities of the short-wave channels to transmit programs over long distances. All four have low-wave transmitters to supplement their regular broadcasting equipment.



Westinghouse Electric and Mfg. Co.

PITTSBURGH'S CONTACT WITH EUROPE

The modulator panel of KDKA's short-wave transmitting apparatus. Inset: KDKA's short-wave antenna. A 60-foot copper rod located vertically to the ground



General Electric Company

SCHENECTADY'S EXPERIMENTAL LOW-WAVE SETS

The oscillator unit of the 100-meter WGY transmitter, showing the water-cooled tubes, one of which is used as an oscillator and the other as a modulator

United States Bureau of Standards Eclipse Observations

Important Spectroscopic, Radiometric, Illumination and Other Observations Were Made by Government Scientists During the Sun's Last Eclipse

Especially Prepared for the Scientific American by Dr. George K. Burgess
Director of the United States Bureau of Standards

MEMBERS of the United States Bureau of Standards staff made spectroscopic and radiometric observations on the sun's corona, color temperature and illumination measurements of the direct sunlight and the north sky, and radio fading observations during the solar eclipse of January 24, 1925.

The spectroscopic observations were made by Dr. C. C. Kiess aboard the United States Navy dirigible, *Los Angeles*, with the chief object of obtaining some record in case the weather conditions were unfavorable for land observations. The radiometric observations were made at Middletown, Connecticut, by Dr. W. W. Coblentz in collaboration with Professor H. T. Stetson of the Harvard Observatory. The illumination measurements were made at the Bureau laboratories by Mr. I. G. Priest, Dr. K. S. Gibson and Mr. F. K. Harris. The radio measurements were made by Mr. T. Parkinson, Dr. C. B. Jolliffe and other members of the Bureau, as part of a cooperative program initiated by Mr. G. W. Pickard of Boston and conducted jointly by Mr. Pickard and the Bureau of Standards.

Spectroscopic observations of the sun's reversing layer and corona were made with a small portable spectrograph in which a concave grating was mounted. The grating has a radius of half a meter and its ruled surface, approximately one and a half inches in width, contains about 25,000 lines. The window in the spectrograph which admitted light to the grating was provided with a glass ray-filter which transmitted only that portion of the spectrum longer than wavelength 4,500 angstroms, the angstrom or Ångström Unit (abbreviated, A) being a unit of the wavelength (λ, lambda) of the vibrations which produce the spectrum. This unit is equivalent to one-100,000,000ths of one centimeter. Wavelengths in the visible spectrum range from about 3,900 to 6,700 angstroms.

Behind the window of the spectrograph was a hand-operated shutter. The dispersed light from the grating fell on the photographic plate which was carried in a slide at the principal focus of the grating. Outside of the spectrograph was mounted a small lens which formed an image of the sun on a ruled screen for purposes of guiding. An alt-azimuth mounting on a tripod supported the spectrograph. The photographic plate used was a Seed 26, panchromatized to the yellow and longer waves in a bath containing pinaverdol, pinacyanol and dicyanin.

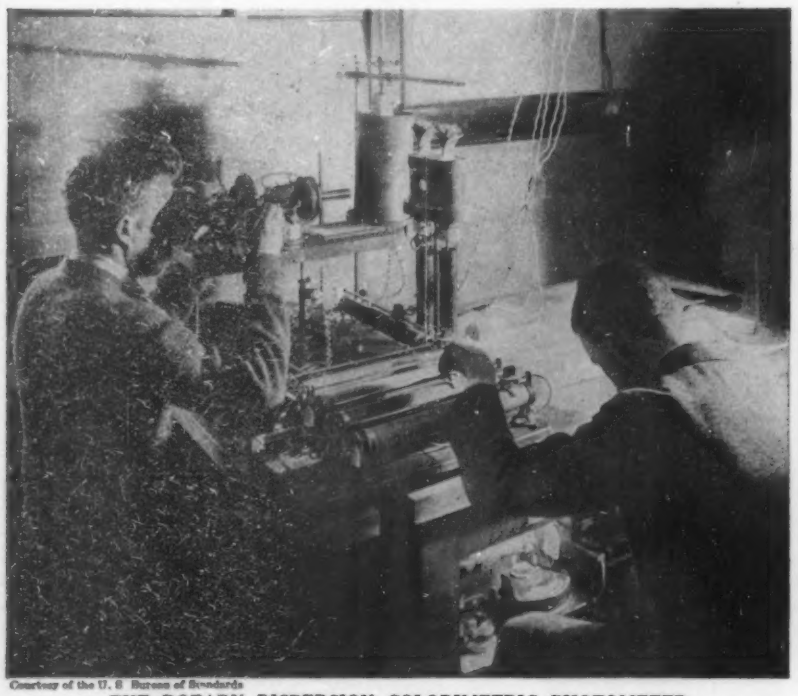
Material Particles in Sun's Corona

Three exposures to the eclipsed sun were made on the one plate. At the instant of totality, announced by an observer stationed in the corridor of the cabin of the *Los Angeles*, an exposure of approximately two seconds was made in order to record the spectrum of the first flash. A new portion of the plate was then exposed for the purpose of recording monochromatic images of the corona. After twelve seconds' exposure the ship shifted from its course, and it became necessary to reset the spectrograph and start a new exposure. The third exposure ran for forty-five seconds, when totality ended.

As was to be expected, from the non-rigid nature of the observing station, the developed plate gave results which are of qualitative value, only. The images of both the flash and corona spectra are blurred and lack the definition which would be expected if the apparatus had followed the sun steadily. Light in the chromosphere was recorded up to a wavelength of approximately 9,000 A. In the corona the blurred images can be traced up to a wavelength of 7,300 A. These images have been identified with known lines in the spectra of helium, hydrogen, and coronium.

These observations are valuable in that they indicate what may be expected and attempted in future eclipses—the possibility of unfavorable weather conditions for good seeing from land stations being ever present.

Measurements of the heat radiated by the sun's corona were made with a vacuum thermopile specially constructed for the purpose. This was placed at the focus of a fifteen-centimeter reflecting telescope mirror having a focal length of about 130 centimeters. The thermopile, of symmetrical design and provided with a fluorite window, which is transparent to practically all wavelengths of the spectrum which the atmosphere transmits, was sighted with one junction on the moon—which thus served as a shutter—and the other junction on the corona. The heating effect obtained on interposing a centimeter layer of glycerine in front of the fluorite window, was thirty-six percent of that obtained with the fluorite alone. From our knowledge of the transmission of glycerine this ratio of thirty-six percent indicated the corona temperature to be as low as 3,000 degrees centigrade, as compared with the sun's temperature of about 6,000 degrees centigrade or 11,000 degrees Fahrenheit. These measurements support the conclusions drawn from previous spectroscopic observations that the corona material is composed, to some extent at least, of solid or liquid particles which reflect sunlight.



Courtesy of the U. S Bureau of Standards

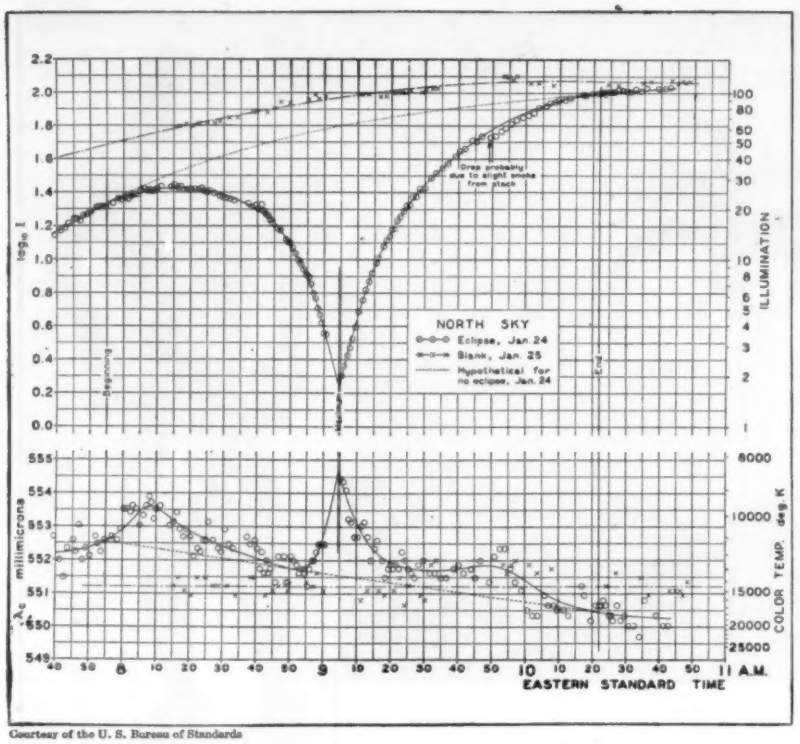
THE ROTARY DISPERSION COLORIMETRIC PHOTOMETER

This sensitive instrument, with its accessory apparatus was used to measure the color temperature and illumination from the northern sky

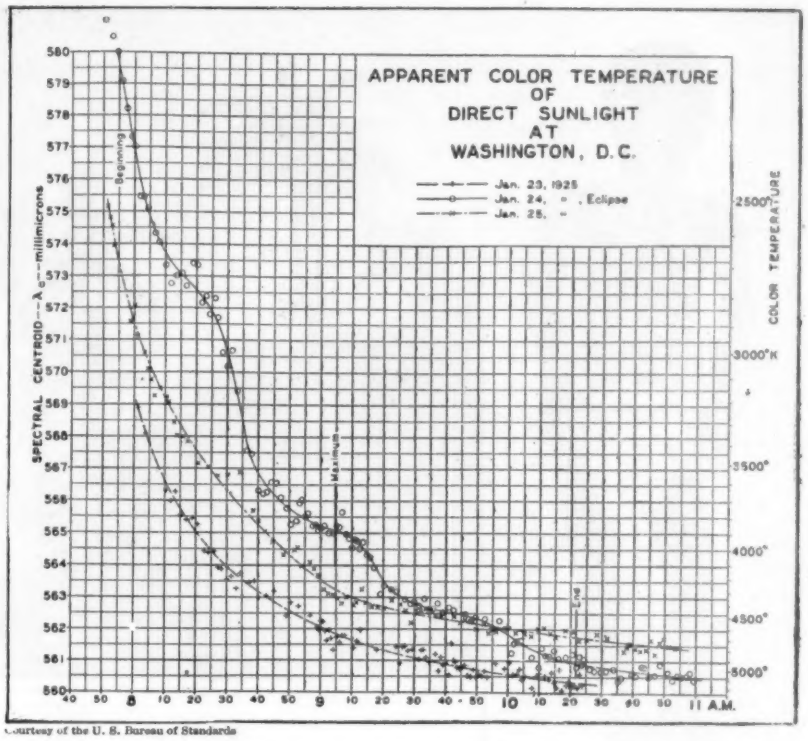
Courtesy of the U. S. Bureau of Standards

RECORDING THE EFFECT OF THE ECLIPSE ON RADIO

A record of the fluctuations of the galvanometer pointer due to changes in signal strength, was made on a moving tape by manual control



Courtesy of the U. S. Bureau of Standards



Courtesy of the U. S. Bureau of Standards

The original inspiration for the color temperature measurements came from articles in the Scientific American by Professors Russell and Brown. Although the observed magnitudes were not different from the expected, their newness on the one hand and their rather unique applicability for future eclipse work on the other, together justify a somewhat detailed review.

The illumination of direct sunlight was obtained by measuring the brightness of a slab of magnesium carbonate, the surface of which was placed normal to the sun's rays. That of the north sky was obtained from the brightness of a similar slab exposed in a horizontal position just outside a north window of the laboratory.

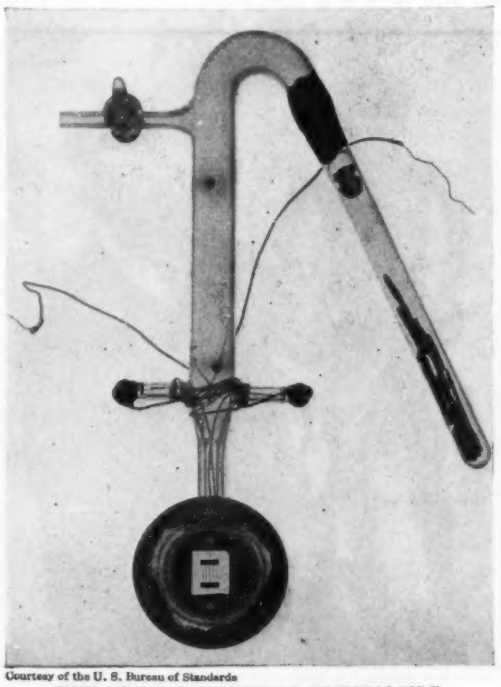
Color Temperature Determinations

The theoretical temperature to which a *complete radiator* illuminating these same slabs would have to be raised to match their color under the given conditions, is the "color temperature" of the direct sunlight or of the north sky as the case may be. A complete radiator is closely approximated by many incandescent solids, for example, filament lamps and the crater of the carbon arc. The brightness and color temperature were measured by comparison with a standard light source using the "rotary dispersion colorimetric photometer." By means of this instrument simultaneous measurements of brightness and color are made. (*Journ. Opt. Soc. Am.*, and *Rev. Sci. Insts.*, VII, p. 1175, December, 1923.) Graphs showing the variation of these two magnitudes during the eclipse period, accompanied by similar comparison curves of "normal" illumination for the same period on the day before, and the day after, are given in the figures.

A study of these graphs reveals that the sky data show a more regular systematic agreement with the phases of the eclipse than the data on direct sunlight. Further, the minimum illumination was about 3.1 percent of normal illumination at the time of maximum obscuration, when, by astronomical calculations, there was still 5.4 percent of the sun's disk exposed. The conclusion is that the brightness of the exposed part is fifty-seven percent of the average brightness of the whole disk. There was an expected color temperature minimum at the time of maximum obscuration, and two unexplained secondary minima in both illumination and color temperature occurring respectively before and after maximum obscuration.

The most interesting and practical feature, however, of the observations is the precision with which the time of maximum obscuration might have been determined from observations on the north sky, had this possibility been foreseen, and the observations taken at more frequent intervals. As it is, the time of observed maximum obscuration differs by only two seconds from that reported to us by the naval observatory. Had the sky been overcast the observations would have indicated the time of maximum obscuration with no less precision. The application to future eclipses is obvious, as such measurements might therefore be the one saving feature of an otherwise futile expedition.

About twenty different laboratories scattered over the northeastern part of the United States, mostly in or near the path of totality, cooperated in radio measurements. The Bureau of Standards participated in the organization of the observing laboratories, and also made observations in its own laboratory and at Fitchburg, Massachusetts. The fading measurements were, in most cases, made by observations of the deflection of a galvanometer connected with a crystal detector connected in a special manner to a superheterodyne receiving set.



Courtesy of the U. S. Bureau of Standards

THE HIGHLY SENSITIVE THERMOPILE

Radiation from the sun's corona generated an extremely weak electric current at the junctions of two different metals within the bright square

The effect of the eclipse was, just as expected, the production of a condition intermediate between daytime and night-time transmission. The variations of radio-wave transmission from day to night depend upon the varying ionization of the atmosphere, and the effect of the eclipse doubtless produced an ionization condition in the upper atmosphere partially simulating that of night.

Bureau Confirms Our Reader's Reports

While the results were erratic and very decidedly masked by fluctuations to which it was not possible to assign any interpretation, an analysis of the records by Mr. G. W. Pickard has shown that there was an effect during the eclipse superposed upon the otherwise meaningless variations, lasting for about an hour and consisting of a decrease in field intensity to a minimum followed by an increase to a maximum and then a subsidence to normal.

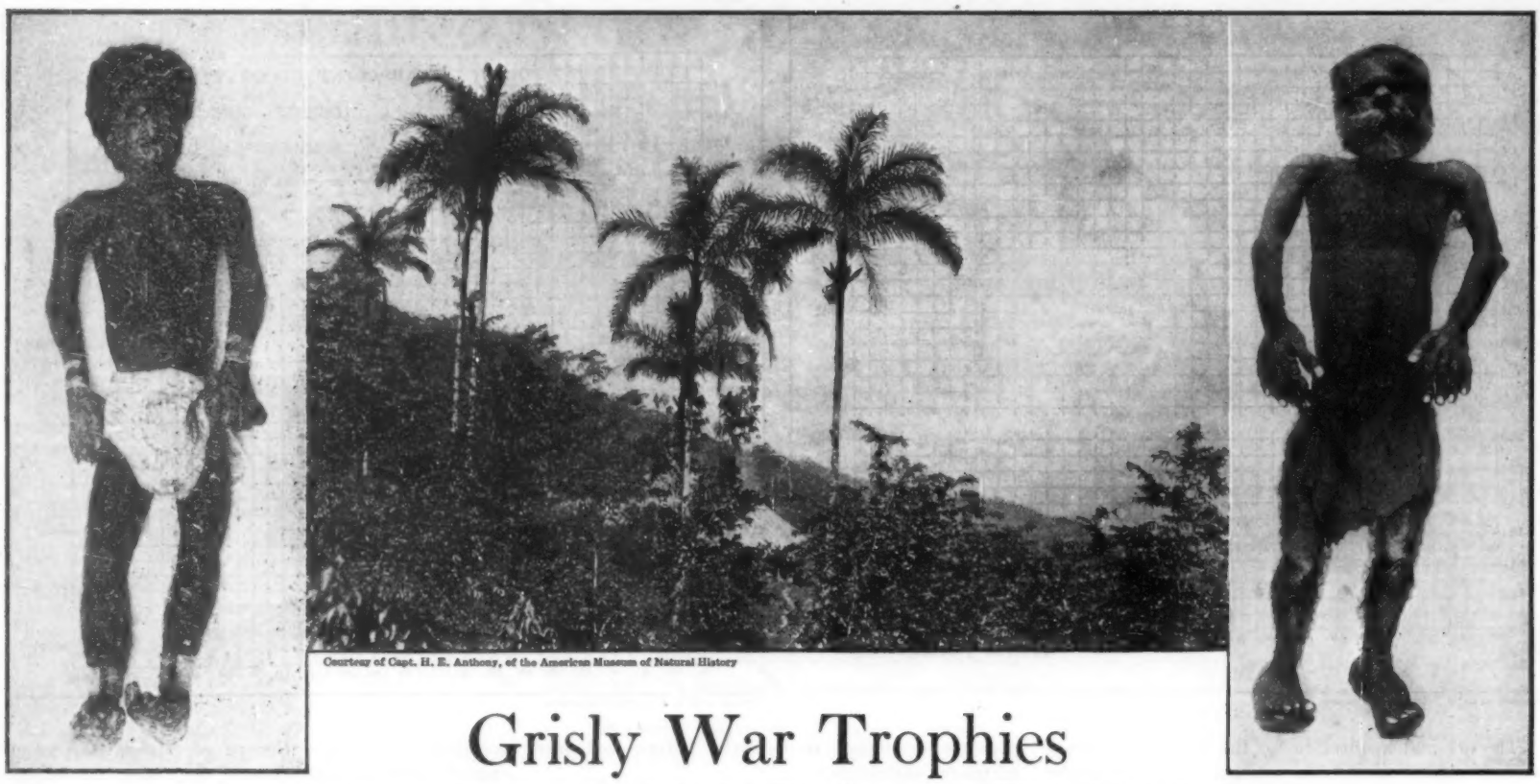
The following general conclusions have been verified in a general way by the reports of observers in a special qualitative investigation of the eclipse effect by broadcast observers organized by the Scientific American.

(a) When the transmitter and receiver were outside the path of totality and on the same side, the effect was an increase of field intensity.

(b) When the two were outside the path and on opposite sides, there was a decrease in field intensity, its period being largely before totality.

(c) When both the transmitting station and the observer were within the path of totality, there was a sharp increase in field intensity practically coincident with totality.

While there is a lack of clear-cut and striking agreements among the results of the various observers, nevertheless the results are sufficient to throw some light on the very complicated problems of radio transmission. They fit in well with recently advanced theories tending to give a more definite picture of the mechanism of ionization which accounts for the vagaries of radio-wave transmission.



Courtesy of Capt. H. E. Anthony, of the American Museum of Natural History

Grisly War Trophies

How the Jivaro Indians Shrink the Heads and Bodies of Their Victims

By Alanson B. Skinner

AMONG the priceless collections from the Indians of South America displayed in the Museum of the American Indian, Heye Foundation, of New York, is a case of grisly trophies from the group of wild tribes called Jivaros, who inhabit the virgin forests of the Province of Oriente, Ecuador, and nearby Peru. Here are human heads, shrunken from the size of yours or mine to the compass of one's fist, and even smaller, yet retaining with perfection every feature, and often the very expression of the original owner. More than this, preserved by the same strange art, there are in the possession of the Museum complete human bodies, reduced to doll-like travesties, a quarter the size of living men.

Warfare the Traditional Occupation

If these weird objects could speak, they could tell strange stories of adventure and savage life in the far away tropic forests bordering the rivers Pastaza, Morona, and Upano-Santiago. Their makers are one of the most numerous and warlike groups of Indians in Tropical America, numbering nearly 20,000, and their country has been severely let alone by the Spaniards ever since the year 1599, when they rose against their white conquerors and nearly exterminated them.

Divided among themselves, the Jivaros recognize no common chief, except in time of war, when a war leader is chosen to govern them all, but ordinarily their life is constantly disturbed by blood feuds, and mutual wars of extermination. Warfare, is indeed, the traditional and accustomed occupation of the men, and the head of an enemy, or his entire body, is a trophy that the Jivaro warrior is trained to search and seek for from his earliest boyhood. It is not only a visible token of his prowess, but a fetish or charm filled with supernatural power.

Because of this, the Jivaros do not dwell in villages like most Indians of South America, but in fortified communal houses, occupied by several related families, built on the summits of hills, or in the easily defended bends of rivers, hidden from prying eyes as much as possible. The houses are surrounded with log stockades, the walls are built double, with loop-holes through which the inhabitants may shoot at an attacking party, and strange fortified doors. Often, especially before firearms penetrated to their jungles, when lance, shield, and blowgun alone were used, these houses were further secured by high four-sided towers built of hardwood at one end. On the summits of these was a room, perhaps 120 feet in the air, where warriors might rain their arrows on the foe. The forest round about was also sown with man traps, pits with sharpened stakes in the bottoms, cunningly concealed, and trees, bent over and fastened down, with terrible wooden spikes to drive through the bodies of unwary foemen who tripped over the cords attached to their triggers.

Courtesy of the Museum of the American Indian, Heye Foundation

A SHRUNKEN HUMAN BODY

Presumably the body of a Spanish officer who was unfortunate enough to fall into the hands of the Jivaro Indians

Yet, in spite of all these precautions, the enemy sometimes were able to surprise and raid an outlying fort, or fall upon an unsuspecting hunter, and bear away his head or body. Or, perhaps, some luckless rubber gatherer or explorer, who, in all likelihood had thought to abuse or maltreat some native, paid the extreme penalty. At all events, the taking of enemy heads is an ancient rite with the Jivaros, and one which has not vanished with modern times. It has, rather, been stimulated by the demand of tourists for specimens of the head-hunters skill as souvenirs, to such an extent that laws prohibiting the taking and shrinking of heads have repeatedly been passed by the South American republics. But, while there are traders to pay a price, and tourists to buy, the boot-legging of human heads will probably continue as an industry for a long time to come.

Method of Curing and Drying Heads

The method of preparing the shrunken heads differs somewhat from tribe to tribe, but in general, follows the method given here. As soon as a Jivaro has killed an enemy, he hacks off his head as close to the body as possible, and carries it away to a place of safety, where he goes through an appropriate ceremony, and slits the scalp from the crown downward to the nape of the neck. Through this opening he flays out the skull, removing the flesh and skin of the face and scalp as carefully as possible. Throwing away the skull, he stretches the skin over a handle made of the wood of some tough tropical vine, and thrusts it for a while into a vessel full of hot water, which causes the skin to contract a little. Then it is hung up on a stick affixed to the ground and allowed to cool. The cut in the skin is neatly sewed up with thread made of fibre, and a ring fashioned from a piece of vine is sewed to the opening in the neck to hold it open.

Next, after a magic rite, three hot stones are dropped inside, and then the process of reduction is commenced by filling it half full with hot sand, and keeping it constantly in motion, in order that it may act on all parts of the head uniformly. When the sand cools off, it is poured out, reheated in a fragment of a broken native clay vessel, and placed back in the head once more. Each time the hot sand is poured out, the warrior scrapes the inside of the shrinking head with his headsman's knife to remove the burnt tissues, and, as the head dries and hardens, he constantly works the features with his hands, pinching and moulding the face so that it will retain its natural appearance, even when reduced in size.

Although the shrinking of the head is commenced while on his return from the scene of the battle, the warrior has to continue it for several weeks after his return to his home. He may not change the sand, nor the pottery fragment in which it is heated, for custom requires him to keep the same ones with which the work was started, until it is finished. At length, after a period of tedious labor, the head is reduced to about one fourth of its previous size, and becomes hard and dry. Three small wooden pins, painted red, are generally passed through its lips, and around them a fine cotton thread is wound. This, it is said, is done to prevent the slain enemy from opening its mouth to curse its taker and his people. The head is then treated with charcoal, to blacken it.

Magic Rites Accompany Preparations of Heads

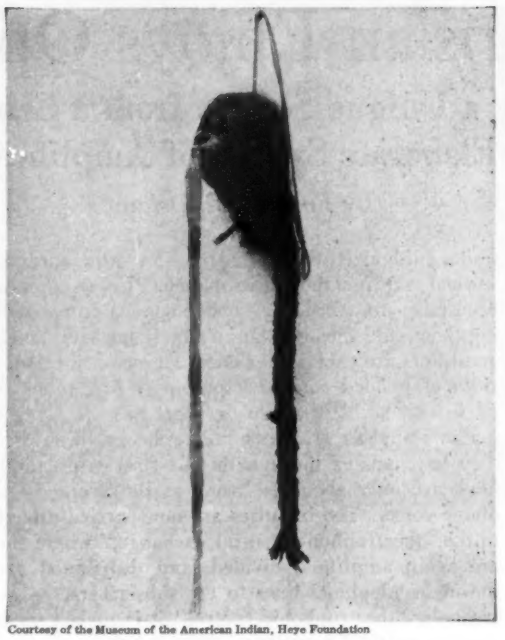
Together with the practical process of reducing the head, goes a series of ceremonies that are as tedious as they are elaborate and expensive. As soon as a succesful warrior returns from the war-path with his trophy he has to undergo a rite of purification, which is only the start, for he must continue these performances at intervals as the head is shrunken, with a grand ceremony at its close.

When the Jivaros hold their ceremonies, they dress in their savage best. Their costumes are gorgeous with a lavish display of the gay colored feathers of parrots and macaws. On their heads are wicker head bands, adorned with pendants made of the brilliantly iridescent green and bronze back and wing covers of tropical beetles, that tinkle as they move. The men wear long cylindrical ornaments thrust through slits in their ears, and the women similar, but smaller jewels thrust through

Museum of the City of Milwaukee

AN UNUSUAL SPECIMEN

The shrunken head of a white-haired white man, now on exhibition in the Public Museum of the City of Milwaukee



Courtesy of the Museum of the American Indian, Heye Foundation

HEAD OF A NATIVE INDIAN

The Jivaros practise their gruesome art not alone on the white man, but on their native foes as well

their lips. Their necks are festooned with necklaces of the teeth of the jaguar and the crocodile.

The guests and participants are summoned to the festivities by the booming of a drum made of a huge hollowed log, swung off the earth and suspended by means of vines. Upon this instrument the Jivaros and their neighbors are able to signal for miles by means of a sort of primitive Morse code. In this way they can not only send out invitations, but warn distant settlements of the approach of danger.

After all these rites have been duly performed, and the task of shrinking the head has been accomplished, the Jivaro warrior, in former times, kept his trophy as a token of his valor. Nowadays, however, with the high prices that prevail at the nearest trading post, he is apt to hurry in to barter it with the white man, and sooner or later, after devious voyaging it usually finds its way into the hands of some northern tourist.

Besides the human heads, the heads of certain animals, especially that curious upside down creature, the sloth, are taken and shrunken by the Jivaros. It is believed by the Indians that these beasts are the warriors of a rival tribe, transformed, and are thus eagerly sought after.

Shrinking of Bodies Rare

The process of shrinking human bodies has never been described by any adventurous travelers, but is probably very much the same as that employed in reducing the heads. It does not seem to be commonly done, and the two bodies in the Museum of the American Indian, Heye Foundation, one of a Spanish officer with a beard, and the other of a negro, are perhaps the only examples in the world, unless others may be still in the hands of the Jivaros.

The staff of the Museum are often asked odd questions concerning the shrunken Jivaro heads. Many people seem to believe that the hair of these trophies continues to grow, not only after the owner was slain, but after they have been through the process of reduction. Of course this is not the case. When the area of the scalp is contracted, naturally each individual hair is drawn closer to the rest, and this causes the hair to appear very much thicker than on a living person. Perhaps this fact has caused the idea of postmortem growth. Another strange idea is that the skull is shrunken with the rest of the head, but, as has been shown, this is not the case, for the skull is taken out and discarded.

Shrunken heads are also popularly supposed to be immensely rare, and enormously valuable. The Museum of the American Indian, Heye Foundation has a very large and complete collection of these trophies, and is offered others, often at a very low price, every few weeks. Evidently the trade is extensive in South America. However, those in the Museum are old examples, prepared purely as trophies, and not offered by the Indians for sale, and show the native art in its purest form.

Primitive "Jazz" to Conjure Forth Victory

In connection with the Jivaros' method of making war, it is interesting to note their strong belief in the beneficent influence of a most important ceremony. About a week before the warriors start on a war expedition they assemble every night in the house of the chief, who develops the plan of the war, gives his men the necessary instructions, exhorts them to take courage, not to fear the enemy, not to abandon their comrades, and so on. Part of these instructions are given during the war dance or exercise with the lance, which is called enema or anekma. The enema is a dialogue between two warriors, who through certain movements of the body, and especially of their lances, give emphasis to their words. Enema with the lance (or with a rifle) takes place not only as a preparation for a war, but also, for instance, when two Indians, who are unknown to each other, suddenly meet while traveling in the forest or when unknown guests arrive at a house. The one party then has to find out who the newcomer is, if he comes as an enemy or as a friend, from where he comes, where he is going, what business he pursues, and so on. The conversation has a ceremonial character, and menacing movements with the lance accompany each word or phrase. The whole enema conversation lasts about fifteen minutes.

When a war expedition is prepared in which many Indians take part, enema is performed on a large scale. The warriors arrange themselves in two rows, one against the other, so that at the ceremony they converse two and two. Enema is then performed simultaneously by all warriors of one row while those of the opposite row stand still with the lances on their shoulders.

The whole thing is a magical ceremony by which the Jivaros believe themselves to be able to conjure forth victory over the enemy.

Courtesy of Capt. H. E. Anthony, of the American Museum of Natural History

NATIVE JIVARO INDIAN

One would hardly suspect from looking at his smiling face that he would delight in collecting heads

How the Parisian Enjoys Opera at Home

Telephone Subscribers Enjoy a Unique Service from a Central Switchboard by Means of an Elaborate System of Amplification

By Frederic M. Delano

PARIS and Munich are perhaps the only two cities in the world that have a regular service of grand opera open to telephone subscribers; and of the two, Paris is unique in having installed a system of amplification at the central bureau which permits listeners to hear the music on the loudspeaker.

The service is, of course, not open to all regular telephone subscribers, being operated by a private company, the *Compagnie du Theatrophone*, which has contracts with both the theatres and the telephone company to handle the distribution of music and other entertainment over the telephone lines. Among the theatres in the agreement are the *Opera*, the *Opera-Comique*, the *Trianon-Lyrique*, and the *Comédie Française*. These four are perhaps the most famous in the French capital; and are the most popular with that large group of Parisians who usually desire to remain quietly at home in the evening to listen to good music or dramatic performances.

Music Over Regular Telephone Lines

The Theatrophone company has a private central switchboard, into which pass the trunk lines from the different theatres, and from which pass the lines which carry the music to their many subscribers. On the stage of the theatre (usually behind the footlights) are microphones—sometimes two, sometimes more. The voices of the actors or singers are transmitted by these microphones to the first stage of amplification.

In a special room in the cellar of the theatre, well away from the possible disturbing elements of the action on the stage, are the amplifying units. Two sets of batteries, one for the microphones and one for the amplifiers, are ranged around the room. The amplifiers are enclosed in large cabinets, two complete units of three tubes being used. They can be either operated separately or together; or in case of emergency, the second amplifier can replace the first.

These amplifiers are very similar to those used in radio, although their construction was specially worked out for the theatrophone. Great care has been taken to avoid any outside sounds from reaching them, and thus creating a line disturbance. The amplifiers are enclosed in large cabinets with double sides of padded cork and the amplifying tubes are set in sockets held by elastic supports.

The impulses from the microphones, even after they have passed through this first series of amplifiers, are only about as strong as the average telephone voice. The impulses are now carried directly to the "theatrophonic central exchange," where they are again amplified, divided, and distributed over the main telephone lines to the subscribers.

At the "theatrophonic central" it is picked up by another series of amplifiers, the usual three-electrode tubes being used; and passed from there after being stepped-up to loudspeaker volume, to the "distributor." This is a sort of amplifier which has as many tubes as there are subscribers.

From the central station the current passes to the jacks of the distribution boards, by which it is sent out to the various city telephone exchanges. The theatrophonic lines are placed in the central stations so that they are automatically protected and insulated from multiple communications, such as bells, or other possible sources of interference. From the P. T. T. *(Postes, Télégraphes, et Téléphones)* central stations, the communication to the theatrophone subscriber is made over the regular telephone lines.

Subscriber Has Choice of Theatres

The operation of the theatrophonic central board is simple, and suggests a regular telephone exchange. The operators come in at 7:00 P.M., take their places before the switchboards, each board being connected to one or more telephone central stations. At the top of each board are the subscribers' lines, with plugs. The board has jacks connected to the distributors, and all that is necessary is to plug in the jack of the subscriber with the plug of the particular theatre he wants.

The operators have before them a list of the subscribers divided into groups. For instance, in making a connection with the subscribers on the "Wagram" exchange, the theatrophone operator opens her key communicating with the city "Wagram" exchange operator and calls off her list of subscribers. In this way she covers all the telephone exchanges, making the necessary connections. Then the city operator calls the subscribers on her exchange, and notifies them that they are now in touch with the theatrophone.

In the meantime the theatrophone operators have plugged in to the theatre. At 7:45 the distributor tubes light up, and the amplifiers are put into service. The primary check-up of the proper tuning and the noise of the audiences going into the theatres, as well as the orchestras tuning up, is done at the central office by a theatrophone engineer.

No Interference With Regular Service

The switchboards are covered with an intricate network of wire, each leading to a jack over a small signal lamp. At times, one of these small lamps will light up, indicating that a subscriber wishes to call the theatrophone exchange, either to change from one theatre to another, or to break the connection so that he may call an outside number in case of an emergency.

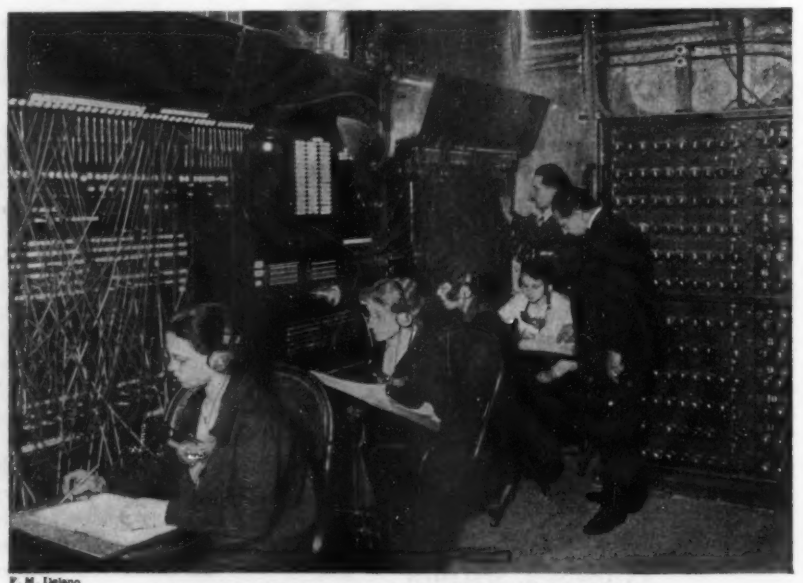
If, on the other hand, someone wishes to call the subscriber from an outside telephone, the call is passed to the theatrophone operator, who informs him that the subscriber is listening to the theatre. If the outside call says that it is really a necessary and important call, the connection with the theatre is broken, and the incoming call put through. The theatre connection can be restored after the conversation has been completed.

The loudspeaker attachment, with the amplifications in the exchange, instead of at the houses of the subscribers, is the important and novel step that has been made in this work. The French were the first to perfect and install such a system, and they are now the first to perfect this distance amplification, which is making the theatrophone a far more popular source of amusement, due to the wider possibilities of entertaining large parties.

F. M. Delano

IN THE THEATRE *TRIANON-LYRIQUE*

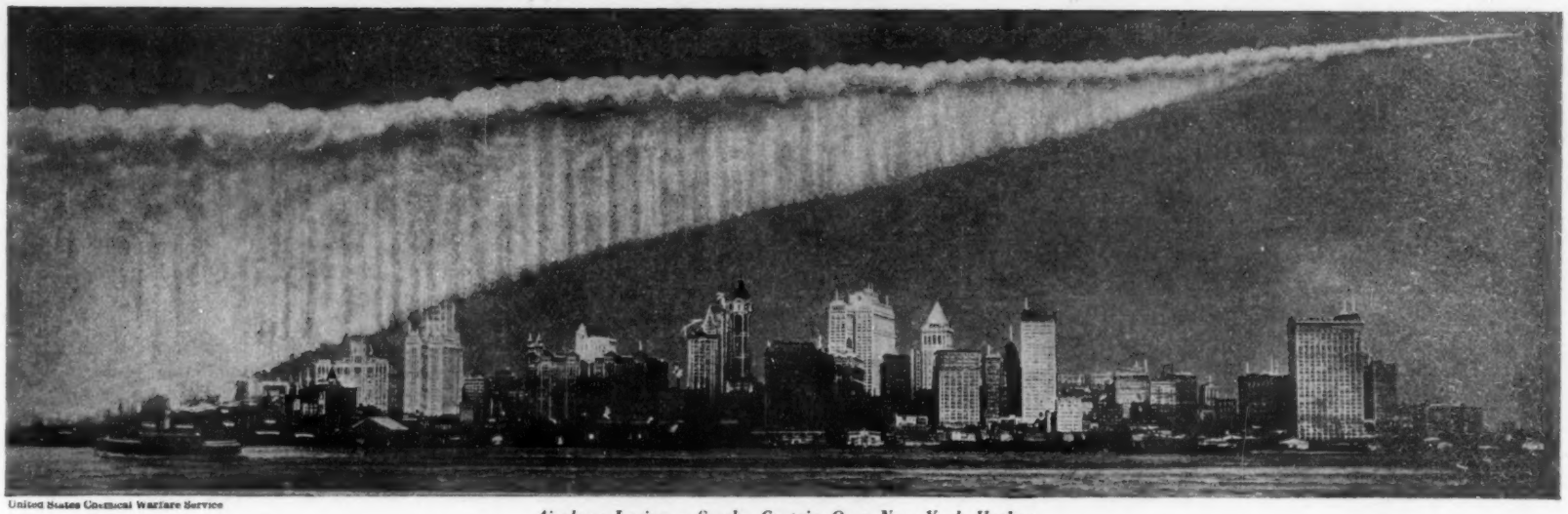
Monsieur Cordon sings not only to an audience before the footlights but to an invisible telephone audience. Note the microphones just inside the footlights



F. M. Delano

THE THEATROPHONE CENTRAL SWITCHBOARD

Into this switchboard pass the trunk lines from the different theatres and from it pass out the lines which carry the music to the many subscribers



United States Chemical Warfare Service

Airplane Laying a Smoke Curtain Over New York Harbor

Chemistry in World Affairs—III

By H. E. Howe

AIRCRAFT problems of today are in a large measure chemical problems. These include materials of construction, not only metals which must have a minimum of weight with a maximum of strength, but laminated propellers protected so that their dimensions and balance may not be disturbed, and a variety of fabrics as well. The varnishes, adhesives, and the many other items which, taken together, give us the aircraft which may suddenly change world affairs depend upon either chemical manufacture or chemical control. The materials of operations, the lubricants, the fuels, which in themselves are difficult problems, also belong to chemistry. Materials for buoyancy, the balloon fabrics which are required to remain flexible and yet impermeable to gases, present a real chemical problem.

Helium appears to be a natural American monopoly and, through chemical engineering, we have learned how to separate it from the other gases with which it is found, purify it, store it, and use it in our observation balloons and airships. The inflammable hydrogen used heretofore has been the really vulnerable point in such craft. In few instances have the sciences had a better opportunity to dictate international relations than in the development of aircraft.

Alcohol As a Source of Energy

Fats and oils of vegetable origin have always held a real place in affairs. Palm and olive oil have been items in international commerce from earliest times. Cottonseed oil with its multiple uses must be credited to chemistry as must also the use of peanut oil. They have even brought about strange tariff problems. With the advent of hydrogenation it lies within the power of any country, possessing the chemical knowledge and skill and the ability to grow such crops as peanut, cotton, and other oil-bearing seeds, to prevent fat starvation among its people.

The hydrogenation of these oils is another example of the efficiency of catalysts. The difference between certain liquid fats or oils and the hard fats like lard is, chemically speaking, an atom or two of hydrogen in each molecule. To add this hydrogen was not so simple, but eventually it was found that the heated oil passing concurrently to a stream of hydrogen in the presence of nickel, the catalyst, took up this hydrogen in the proper form and upon cooling a hard fat resulted. Sixty million pounds of such fats were made by a single plant in the United States in 1922. It has meant an increase in the value of many oils which have thus been elevated from raw materials in manufacturing processes like soap-making, to food uses, leaving a place in turn for cheaper oils which after hydrogenation have become suited to become their successors.

No one doubts that power in the future will rest very largely with that nation which controls such sources of energy as petroleum or the materials from which future fuels may be made. Today, as for years, oil fields are an international question. The utilization of the various compounds in petroleum depends upon chemistry. Far-sighted scientists have for some time been conducting research in possible substitutes for petroleum, and in Germany $5,000,000 has already been invested in research designed to produce a method for making liquid fuels from coal by hydrogenation and chlorination. Intensive work is under way in our own country on improved methods for cracking off those parts of petroleum which are suitable for internal combustion motors.

Sperry Gyroscope Company

A LARGE MIRROR

A thirty-six-inch parabolic mirror used in searchlights for airplanes

All over the world people have been looking to alcohol as a source of energy. The problems are economic rather than technical and depend to a large extent on our ability to find cheap annual crops sufficiently rich in starch or the type of cellulose that can be converted into fermentable sugars to produce cheap alcohol. These processes may require fuel having energy nearly equal to that of the alcohol produced, but these fuels themselves cannot be used in internal combustion motors. Coal may become essential to motor-driven vehicles, for the production of gas, benzol by-products and electricity, and the opinion has been ventured that hydro-electric power may be called upon to furnish the energy for electric motor vehicles. The desire to use high-compression engines has introduced the great problem of so-called anti-knock compounds.

Tropics to Feed the World

The internal combustion motor must also be considered in the light of what our future source of food may be. Many expect the tropics eventually to feed the world. Man has largely conquered the forces of nature in the temperate zone through the use of such domestic animals as the horse, but these animals are not suited to the tropics. The motor may consistently be looked upon as a means by which man may overcome the tropics, so that this whole problem of fuel and food which lies at the very basis of all civilization may be directly concerned in tropical agriculture.

An example of how chemistry works through and in cooperation with other sciences in influencing international relations is the parabolic mirror for searchlights. For many years one concern abroad made practically all the parabolic mirrors of large dimensions and thereby obtained world business in searchlights, signaling apparatus and military equipment. Starting with a great mass of glass (itself a chemical compound), an abrasive (another chemical compound) was used to create the curves designated by the mathematical optician. The polishes which followed the abrasives are also chemical compounds and when the mirror had been formed, ground and polished on both sides, it was ready to receive a coat of silver which could not be applied but for modern chemistry. This coat of silver was then protected by a coat of copper deposited from an electrolytic bath, made up in accordance with chemical formulas.

In the War of the Revolution opposing forces are

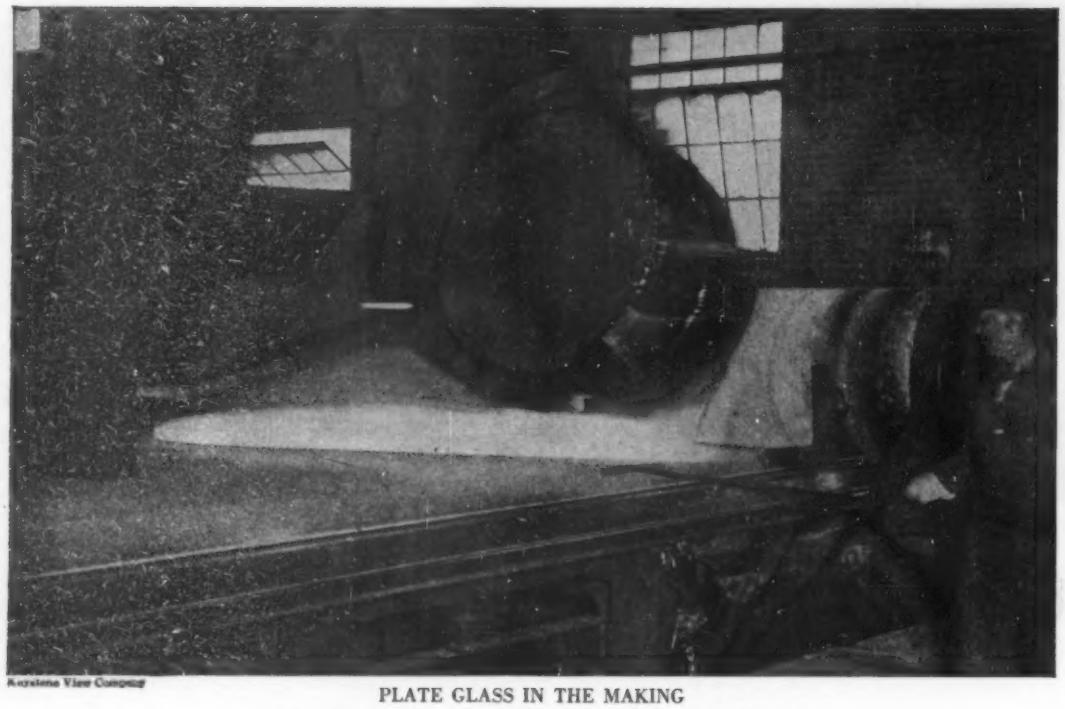


PLATE GLASS IN THE MAKING
Pouring out the molten glass on the slab before rolling

said to have held their fire till they could see the whites of the combatants' eyes. By the time of the Civil War the range had lengthened, but firing was often point blank. In the Spanish-American War 5,000 yards was the maximum graduation required on the range finders. Now it is the horizon which must be within the measurement of the larger range finders, and we have gone on to sound ranging, observation balloons and data secured by the airplane. In all this distance work optical instruments are essential and for their manufacture ordinary glass will not do.

Not so long ago a single nation controlled the production of the finer grades of optical glass and was successful in discouraging its attempted manufacture elsewhere. The shortage of glass early in the World War was a really serious affair and but for a stock which happened to be in this country, alarming consequences might have resulted. However, optical glass is a chemical product and American chemists overcame the handicap.

Glass makers of long experience marvel that these scientifically trained men became familiar with and solved production problems so quickly. Early in the work chemists who had specialized in the chemistry of the silicates were able to evolve a diagram from which they could predict the physical characteristics of glass from its predetermined chemical composition. When this work had been demonstrated as successful, there was no longer any difficulty in obtaining the cooperation of experienced makers, with the result that no finer glass has ever been produced than that made in this country.

Chemical Warfare a Leveler of Nations

From the earliest times disease has been an overwhelming factor in international relations. It is now thought that the Aztecs were conquered not by the Europeans but by the smallpox which the Europeans brought with them. Greece and Rome fell before malaria which has persisted there to this day and has made progress in some countries almost impossible. In our own day the Panama Canal became possible only when disease was conquered, and the white man can never realize on the wealth of the tropics until ways are found for protecting him from numerous tropical fevers, sleeping sickness, and other diseases. Perhaps in no war were such great pains taken to protect and keep normal the health of the forces both in the field and at home as was the case in the recent World War.

Modern sanitation, preventive medicine, and the development of first-aid treatments make many an outpost tenable which otherwise could not be held and constantly extend to the furthermost parts of the earth the influence of those nations which have seen to it that their scientific development has not been allowed to lag.

Chemical warfare, a development forced upon the world through the acts of a single nation, is capable of becoming the most feared, humane, efficient, and financially economical military weapon. Despite treaties and prejudices it remains one of the few outstanding factors of today in its influence upon world relations. It places a premium upon intelligence, for in chemical warfare it is the intelligent who are best able to defend themselves and attack the enemy. It is in large measure a leveler of nations, since a small country efficient in chemical warfare is more than a match for a great country unprepared.

We know, of course, that radicals deplore chemical warfare and continually strive for its abolishment, for they know how it can seek them out in case of an uprising. Many able military men deprecate its potentialities because it forces a new order of things while they have grown accustomed to the old; but, the world over, it is recognized that the nation which knows most of the fundamental science, chemistry, upon which defensive and offensive chemical warfare rests, may some day dictate international policies.

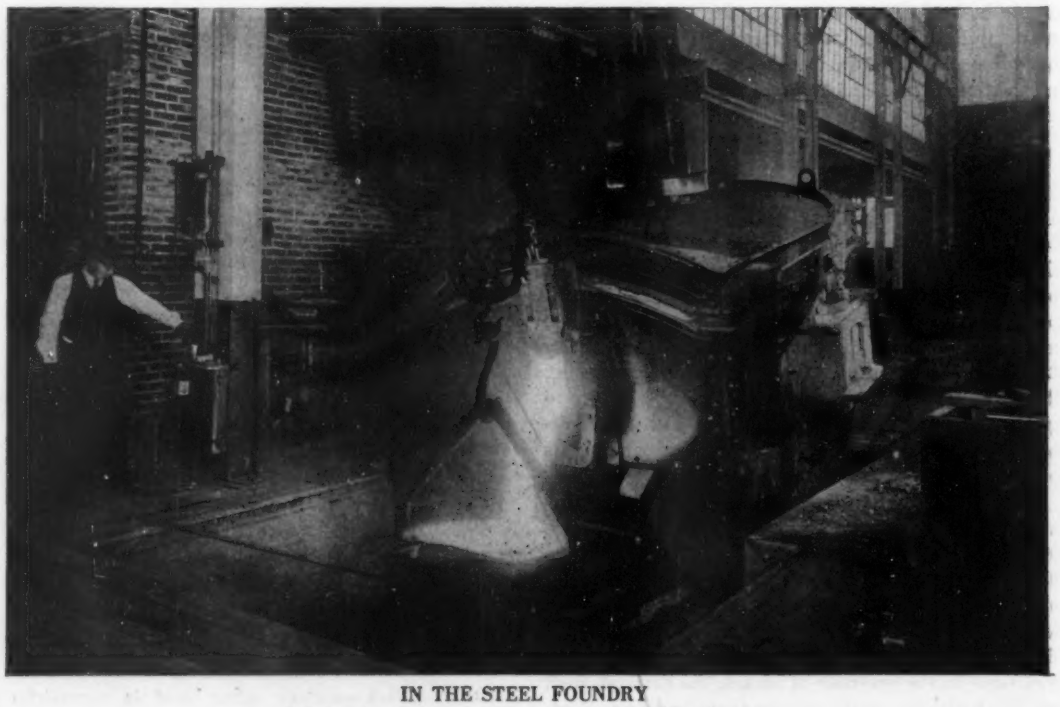
Electro-metallurgical products have not been without a part in these international relations. Without foreign magnesite for the linings of steel furnaces, it might have been difficult to produce ferrous alloys to the exacting specifications of the war period. But we learned how to use domestic linings, and thanks to success in the production of artificial graphite, there was no difficulty in providing huge electrodes for steel furnaces with a uniform quality and the dependable characteristics which were essential.

Rubber an Item of World Importance

Ferro-chromium, necessary in armor-plate production, is also used in making projectiles. Ferro-silicon is an essential for basic open-hearth steel production which makes up the greatest part of our steel output. Without ferro-silicon we could make no sound steel castings nor shrapnel. Without ferro-tungsten and the other tool-steel alloys, our munition production would have been in a sad plight, for it is with such steel that a lathe which has been using high carbon steel can be made to nearly triple its output.

Calcium carbide, from which acetylene is produced, became important in the last war in an unexpected way, for this acetylene became the source of solvents which heretofore had only been made by the distillation of certain hardwoods. Today, the electric furnace is being turned to many other production problems, including phosphoric acid from the phosphate ores and a process for sodium carbonate which may eventually displace those now so well established.

A discussion of this sort would be far from complete without reference to rubber. A moment's thought will indicate its extended use in insulation

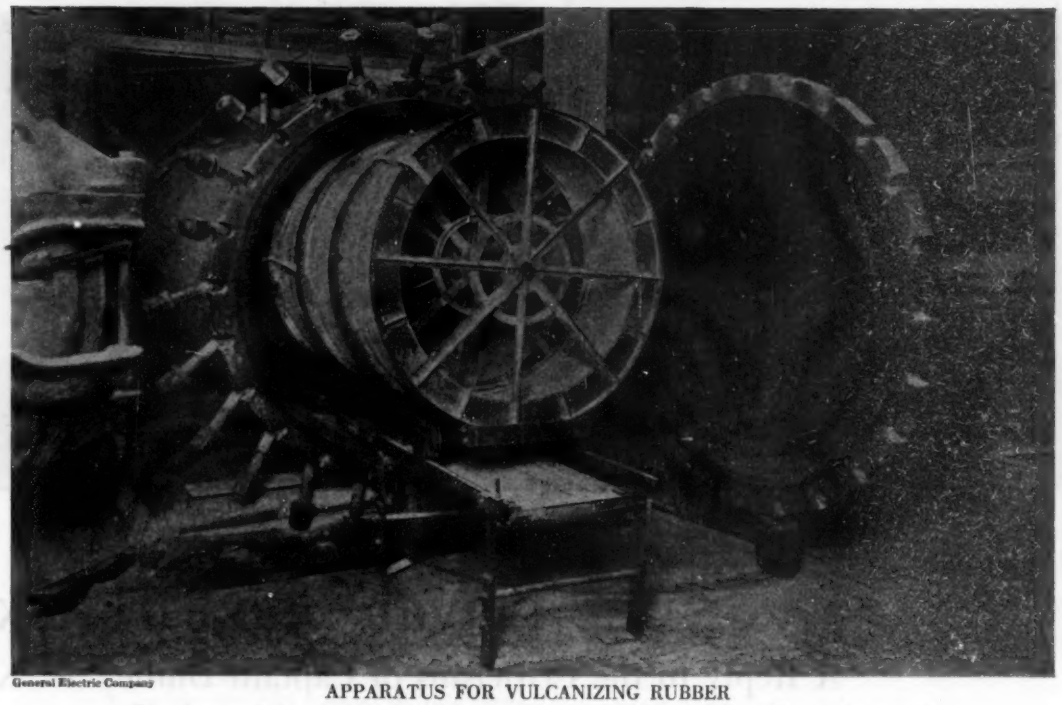


IN THE STEEL FOUNDRY
Pouring the melt from an electrical steel-melting furnace

which is so necessary for modern methods of communication and in many parts of modern transportation systems, besides the automobile tire, as well as for weather, water, and wind proofing. For balloon fabrics, gas masks, and scores of other items it is essential.

While there is no country in which the manufacture of rubber products has been developed so extensively as in the United States (we use 75 percent of the world's rubber), the center of crude rubber production has shifted from the western hemisphere to the eastern, and we are now not only without sources of crude rubber controlled by us, but we have no facilities for training men to perform the special task of managing and developing rubber plantations. Certainly no thoughtful nation would allow this condition to continue, for rubber as an item of world importance can no longer be ignored. Our government is taking the first steps to remedy this condition by conducting a crude rubber survey. The synthesis of artificial rubber must also be developed.

One of the latest contributions of chemistry to the rubber industry has been the development of organic accelerators. With these organic compounds vulcanization can be carried on in something like 20 percent of the time formerly required.



General Electric Company

APPARATUS FOR VULCANIZING RUBBER

The shape and size of the vulcanizer depends upon the shape of the rubber to be treated

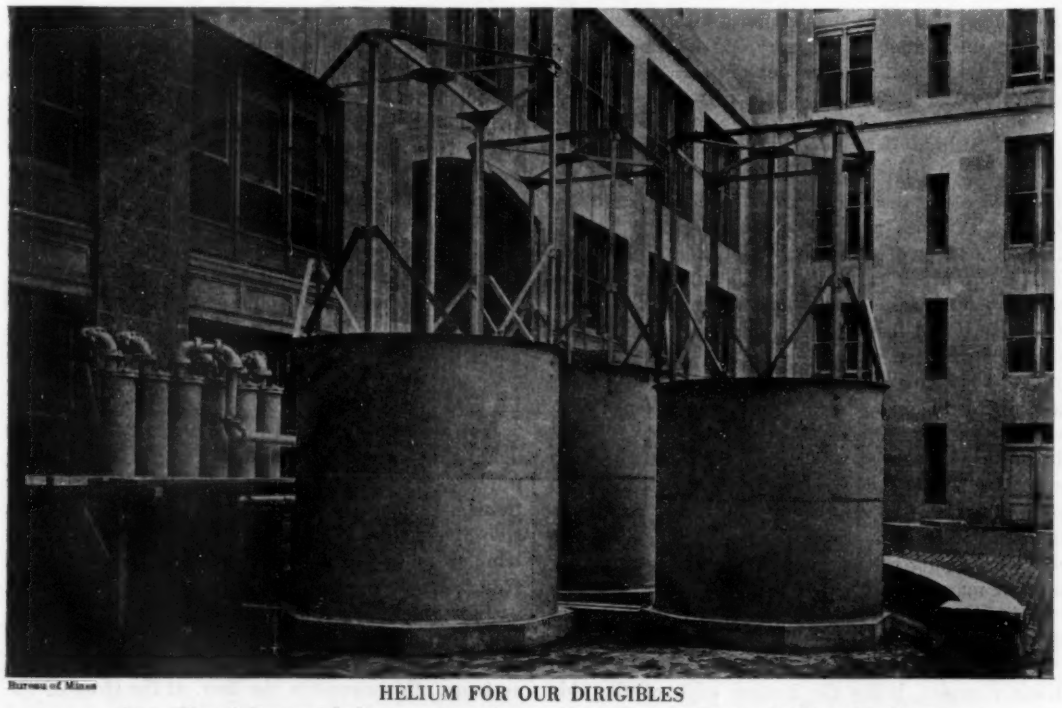
Science Annihilates Time and Distance

The products of peace-time research are knowledge, skill, and technical perfection, which present no storage problems and find their healthful exercise, not in playing at war nor in its foment, but in the chemical industry. The relation of research to sanitation, the destruction of insects, rodents and other pests, and the importance of developing a real center for toxicological information are obvious.

The accomplishments of modern science, particularly chemistry, are so startling that the impossible is accomplished almost daily. No sooner are invisible uniforms devised than the chemist-physicist develops a color screen through which they appear as a flame on the landscape.

In view of the fundamental research now in progress upon the structure of the atom and the molecule, it is not unreasonable to believe that the chemist will have obtained the skill which will enable him to produce uniformly and in quantity the types of molecules specified. When the physician understands what is required to combat a new form of disease or to overcome an old one, he may, and before long, specify to the research chemist the type of molecule which will be efficient in overcoming it. This does not seem so visionary when we remember that we already have available many wonderful medicines and remedies, the counterpart of which is not found in nature, and that we have indeed set up, as in the use of mercurial and arsenic compounds, a molecule that will conquer the organism invading the body without disturbing that extremely delicate balance which characterizes the human being.

The contributions of science and particularly of chemistry have been the means by which we have made our world grow smaller. Through modern methods of communication and transportation we have become near neighbors to nations which formerly were so far away as to seem to be on another star. In the short space of a hundred years developments in electricity and a little knowledge of the radioactivity of matter have produced wireless telegraphy and telephony.



Bureau of Mines

HELIUM FOR OUR DIRIGIBLES

Air purifiers, helium and hydrogen storage plants in the yard of the Interior Building, Washington

With an increase in our knowledge of how to make energy available and how to apply it efficiently has come a speeding up of all kinds of transportation. Printed matter is distributed throughout the world. Pure and applied science has gone a long way toward eliminating time and distance in international affairs and in consequence the peoples of this world must learn to live closer together. Perhaps this also may be accomplished through science and scientific men. Their labors make life easier, more profitable, and longer. Their products instruct, entertain, and protect us, and are known as more abundant, more pleasing, and better things to wear, see, hear, eat, possess and apply in lightening our labor.

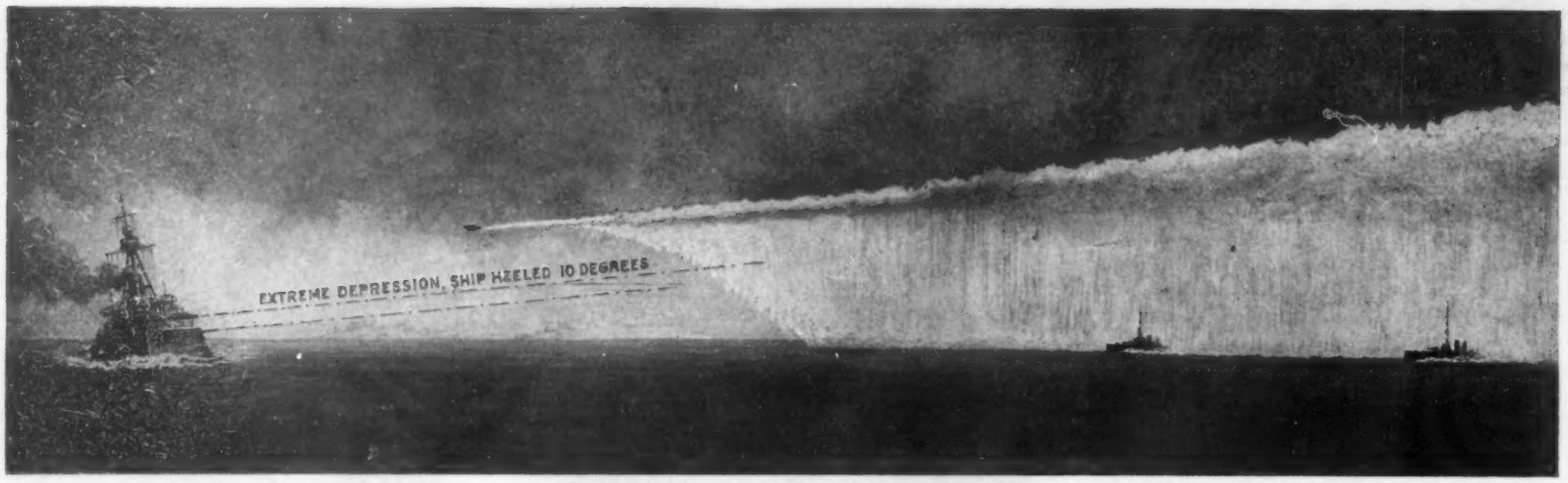
Chemistry an Ally of World Peace

All this is but a part of the story—just a few illustrations of what chemistry does to justify the designation of a "key to international relations." The safety of a country's world position and its influence in international relations may, indeed, be measured by the degree to which fundamental research is fostered, science applied in the solution of industrial problems, and by the extent to which its people appreciate the significance of chemistry.

In most respects the signs of the times are encouraging to America. While at the moment our facilities for trained men exceed the demand for them, yet support is being given pure research. Our university and college equipment is being greatly improved, so that America may assume world leadership in fundamental research. Industries are also turning to science. More than forty trade associations include research in their program of activity. Our military establishment realizes that no treaties forbid the acquirement of knowledge, which is the really vital factor in defense. For the sake of a peaceful future, it behooves America to make an ally of chemistry and of all science.

History is replete with examples of nations which have tried all manner of physical means to exclude the rest of the world and grow strong within their own boundaries. Superior intelligence has usually been the overpowering force.

More and more the key to international relations and national prosperity becomes superior knowledge obtained only through the encouragement of invention and the support of research in the sciences.



Destroyers break through screen and make close-up attack, while battleship's guns, because of super-elevation, cannot bear

Some Naval Theories Exploded

A Reply to the Criticisms of Captain Dudley W. Knox, U.S.N. (Ret.)

By J. Bernard Walker

WE published in May an article entitled "The Last Word on the 5-5-3 Ratio," in which we stated that the House Naval Committee, after exhaustive examination, had come to the conclusion that our battleship fleet is fully up to the 5-5-3 standard. We quoted the words of the Secretary of the Navy who, speaking before the committee and referring to the claim that we were outgeneraled in the Limitation of Armaments Treaty, said: "The fact is that we got exactly what we proposed." The object of our article was to bring before the American public the fact that, so far from our Navy being out-ranged by the British Navy, the five most modern ships of our fleet have a superiority of range of from 10,000 to 11,000 yards. This astonishing fact was known only to a comparatively few officers of our Navy; it certainly was not known to the general public, which was being misled by the oft-repeated statement that we were wofully outranged by the British fleet.

In our August issue, Captain Dudley W. Knox, U. S. N. (Ret.) replied to our article in the May issue. He made the following criticisms: first, that we advocate no appropriations for modernization but only for repair work; second, that we are wrong on the question of firing ranges; third, that we have misstated the relative speed of the two fleets; and fourth, that in stating that the ships will fight in column we are one hundred years behind the times.

Before taking up the questions of gun range, speed and tactics, we wish to clear the air by stating that we are entirely in agreement with Captain Knox as to the wisdom of carrying out full modernization so far as it comes within the limits of the Treaty. We admit that the last clause in our May article does seem to confine appropriations to those necessary for repair work; but the omission of modernization was not intentional. Repairs should come first; but modernization in the shape of bulges and the substitution of oil for coal firing should follow, or rather, should be contemporaneously carried on. Everything that the British have done or which they are authorized by the Treaty to do we must do ourselves if we are to maintain equality.

In our May issue we showed that five of our ships out-ranged the British fleet by the enormous amount of 10,000 to 11,000 yards; that the next five of our ships are approximately of the same range as the British ships, and that the remaining eight ships are out-ranged by about 2,800 yards by the British ships; and we claimed that since, during the approach of the two fleets, the British would be for half an hour under fire of our 16-inch and 14-inch shells without being able to make a reply, the head of their line would be crushed before the engagement became general. Captain Knox, however, still claims an average superiority of range for the British ships and he substantiates his claim by one of the most amazing propositions which has ever come to this desk on naval matters. Because he finds in Admiral Bacon's book, "The Dover Patrol," a photograph showing an anchored battleship engaged in bombarding the Belgian coast (the anchor chain can be seen at the bow; the bow wave was painted in by some imaginative artist), said battleship being heeled over some ten degrees to give increased range to her guns —because of this, and because the ship had side bulges which were, presumably, emptied or filled to give the desired heel, Captain Knox makes the astounding statement that ships of the British fleet, having such bulges will, on going into battle, put themselves several degrees out of trim and thereby secure an additional 5,000 yards of range.

Bulges Not Needed for Heeling

Now, to the lay mind, this statement conveys the impression that the 5,000 yards additional range will be due to that excellent contrivance, the outside bulge. As a matter of fact, a ship does not require bulges in order to heel itself. Any one of our straight-sided ships, by transferring water or oil from starboard to port, or *vice versa*, could get all the heel required for any additional 5,000 yards of range. If ships with bulges can get 5,000 yards additional range so can we. But as a matter of fact, no commander of a fleet about to enter a great line-of-battle engagement would be guilty of such egregious folly as deliberately throwing all the ships of his fleet several degrees out of trim. Any commander-in-chief, American, British or Japanese, who did what Captain Knox suggests would be ripe for a court martial.

That this suggestion is impracticable will be evident from the following considerations:

First: Such heeling of a ship would, as Captain Knox suggests, bring the bottom edge of the side armor close to or above the water line; and this is a condition which, in view of the rapidly changing conditions in a great sea fight, would render the ships liable to be holed below the belt, even by medium-calibre shells.

Second: Throwing the ships out of trim would have a very disturbing influence upon their steering. A ship's captain knows exactly where his ship will go with a given angle of helm; but with his ship heeled as suggested, an element of great uncertainty would be introduced, and under the conditions of a heavy torpedo attack, this uncertainty might well be fatal. At one period in the Battle of Jutland, the Germans made a strong destroyer attack; and it was only by skilful steering that disaster was averted. Jellicoe states that no less than twenty torpedoes passed through his battleship line, all of them being avoided by the use of the helm; and, even at that, not a few of the torpedoes passed only a few yards ahead or astern. Uncertainty as to the steering of the ships might well have brought disaster.

Third: Increasing the range by heeling the ship presupposes that the firing will all be done from the higher side of the ship—a very large assumption which is not warranted by the course of events in the engagements of the Great War. The tactical situation may become such as to render it necessary to make a decided change of the course; it may even be necessary to reverse the position of the ships entirely. This is what happened in the great Jutland Battle, when the Germans found that the British fleet, in maneuvering to pass around the German column and interpose itself between the Germans and their home ports, had actually enveloped the head of their line and were crushing it in by a heavy concentrated gun fire. To extricate himself, Von Sheer reversed his whole battle line, thus withdrawing from the envelopment.

Now what has happened once might easily happen again, and the turn would be completed in a few minutes. Obviously, such a turn would call for the transfer of the oil or water from the low to the high side of the ship so as either to bring her to an even trim or to insure that she should change the heel from port to starboard or from starboard to port, as the case might be. The transfer of large quantities of water or oil ballast to the opposite side of the ship might well take from twenty minutes to half an hour. Consequently, the fleet, at the close of the movement, would find itself with its guns depressed

APPROACH OF TWO FLEETS AT JUTLAND

British approaching in six columns deploy to port to form single column. The battlecruisers (Lion class) move up to head the column; the 25-knot battleships (Barham class) form the end of the line

instead of elevated above their normal position; in other words, applying this to the British ships, instead of having an additional range of 5,000 yards, they would find themselves 5,000 yards or something less to the bad. The range would drop from 29,300 (24,300 plus 5,000) yards to 19,300 (24,300 minus 5,000) yards.

Fourth: The most serious risk, to our thinking, would be from destroyer attack with the torpedo; for the anti-torpedo battery on the high side would be lifted so high that its guns would be firing over the head of any destroyer flotilla that dashed in for a close-up attack. Naval guns are so mounted that they are capable of being depressed five degrees below the horizontal. This is done to enable them to bear on an enemy ship that may come within close range, say of 2,000 yards or less. A heel of ten degrees away from the enemy would eliminate this five-degree depression and would cause the anti-torpedo battery to be five degrees above the horizontal, even when the guns were depressed to their full extent; and with five degrees elevation, their projectiles would land several thousand yards away from the ship and not a shell could be dropped any closer. In other words, there would be a zone of several thousand yards in which an enemy ship would obviously be immune from gun fire.

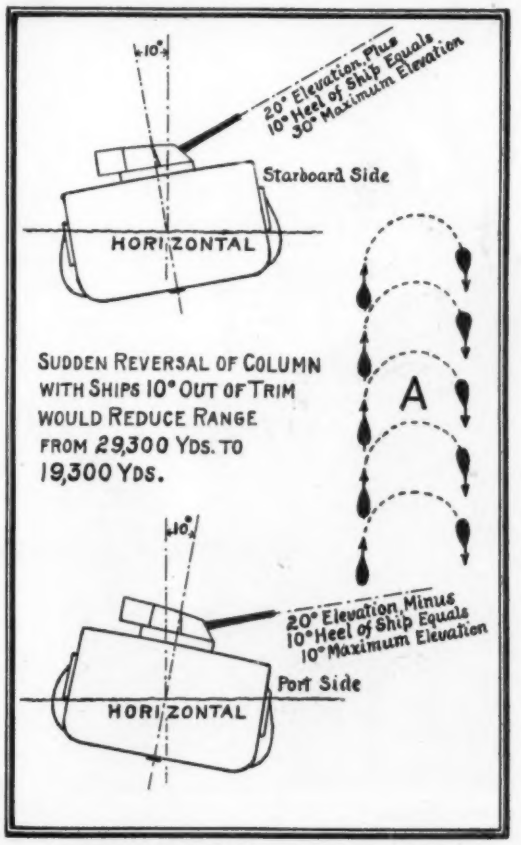
At the Destroyer's Mercy

Now, as soon as the enemy scouts, cruisers, or destroyers observed that the opposing fleet was heeled in the fashion suggested, they would realize that the situation was ideal for a close-up destroyer attack at point-blank range; and the obvious tactics would be to send out two or three planes and lay a smoke curtain a thousand yards or so from the enemy fleet and send in a destroyer flotilla with instructions to approach behind the shelter of the curtain, break through it, and deliver an attack. The destroyers could come in just as close as they pleased, for not a gun of the enemy could be depressed sufficiently to bear upon them.

Summing up, then, we find that the possession of bulges does not confer any advantage of range, since the ship without bulges can heel itself to any degree desired and thereby increase its own range to the same extent; and secondly, the risk of putting one's self out of trim, due to hull exposure, loss of steering control and liability to unhindered torpedo attack, is such as to render it apparent that Captain Knox's suggestion is utterly impracticable.

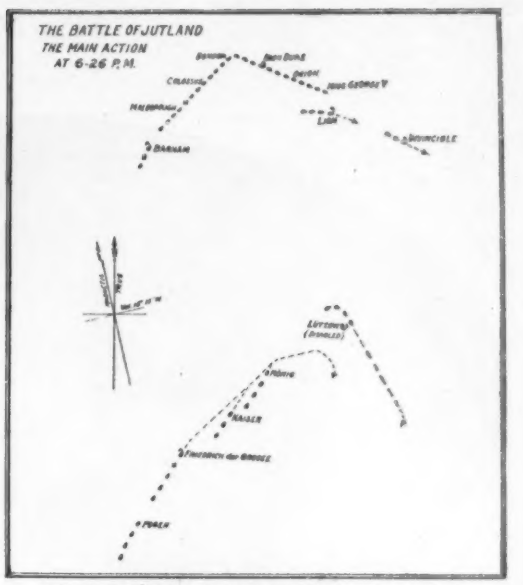
Captain Knox states that we are one hundred years out of date in supposing that future engagements between opposing fleets will be fought with the ships in column. He believes that a fleet like that of the British, which contains many ships of high speed, will break itself up into separate sections, sending the fast ships on to the flanks of the enemy—that is, either to the head or the end of the enemy line-of-battle—and leaving the slower ships to attack the center. Now, the only way to determine that question is to study what was done in the last war. When Von Spee fought Craddock off the Chilean coast, the two squadrons fought in line-ahead at a distance of about 12,000 yards. Later, when Sturdee overcame Von Spee at the Falkland Islands, the two fleets again fought in column; and the column was only broken when the German light cruisers scattered and were pursued by the fast cruisers of the British fleet. The Dogger Bank action between the battle cruiser fleets of Germany and Great Britain was also fought with the respective fleets in column. In the Battle of Jutland, the same thing happened.

We present two diagrams showing this. In the first, Jellicoe comes down from the northwest with his battleships steaming in six parallel columns; and before getting within range, he swings off to port, bringing his fleet into column or line ahead. According to Captain Knox, he should have sent the 25-knot battleships of the *Barham* or *Queen Elizabeth* class to attack the flank, let us say the after end, of the German fleet, and should have thrown his battle cruisers far ahead to concentrate on the head of the German line. As a matter of fact, we see from the second diagram (both of these diagrams are redrawn from the Admiralty charts of the battle) that Beatty, in the *Lion*, led his fast battle cruisers across the British fleet to place himself at the head of the line, and that the *Invincible* battle cruisers, coming in from the west, made a turn of over 180 degrees to take position ahead of Beatty, while the *Elizabeths*, headed by the *Barham* fell into line



HEELING SHIPS A DANGEROUS MOVE

In an engagement the column may have to be reversed suddenly. This maneuver, if ships were heeled, would find them with range greatly reduced



BATTLE OPENS WITH FLEETS IN COLUMN

The line-of-battle completed, with the battlecruisers (Lions and Invincibles) in the van and the Barhams astern. The British line curves around to place itself between Germans and their home ports

immediately astern of the battleships, thus completing the column.

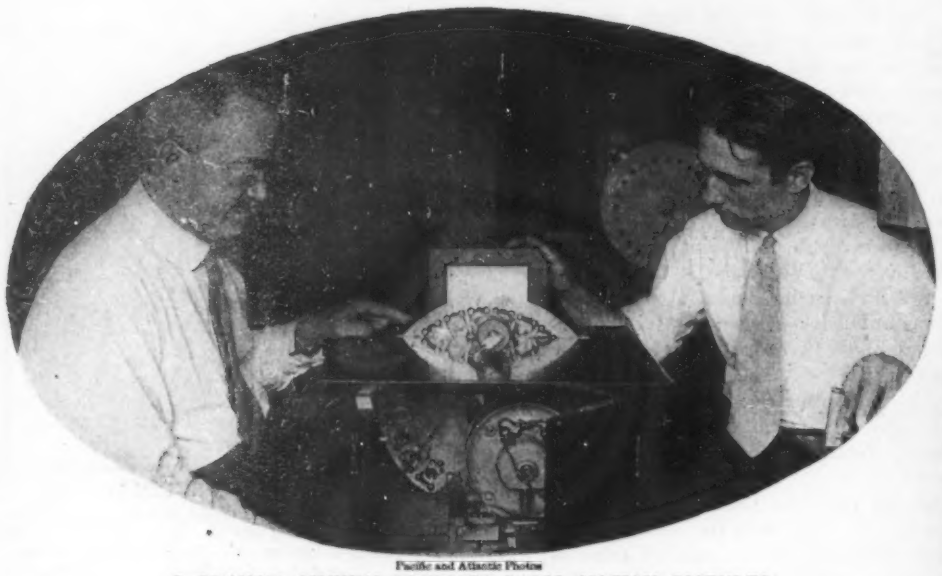
Similarly, the German battleship fleet approached in column with the battle cruisers heading the line. The aim of Jellicoe, as he states in his book, was to place his fleet to the eastward of the Germans and cut them off from their home ports. Hence, the British fleet worked itself, in a broad sweeping curve, around the German fleet; but Jellicoe never, as long as daylight lasted, deliberately broke up the line but continued in column until nightfall.

In an engagement between fleets as evenly matched in gun fire as the British and our own, no British commander would send off his fast ships to the flank of the opposing fleet. This might find the remaining nine vessels exposed to the concentrated fire of our whole fleet. These lightly armored cruisers on our flanks would be helpless. They might go to the flanks, but being outranged by our 16-inch guns they could do no effective work. In spite of his great superiority in numbers and strength, Jellicoe kept his fleet together. When two fleets are as evenly matched as would be the two Treaty fleets under consideration, it may be taken as certain that for mutual assistance and for the sake of concentrated strength, each fleet would be held as long as possible in line-ahead or column formation.

One Hundred Years Out of Date

Finally, Captain Knox, in his endeavor to show that the gun fire of the British fleet is heavier than that of our own, is himself guilty of being one hundred years out of date; for he makes a comparison merely on the basis of the total weight of projectiles fired. This is certainly an anachronism. In the days of Nelson, John Paul Jones and Hull, the strength of the batteries was measured by the *weight* of shell delivered—this for the reason that all the smoothbores of that day had the same very low velocity. But in these days of smokeless powder and high velocities, the power of a ship's battery is measured not by the mere weight of the shell but by the *striking energy;* and this striking energy varies as the weight of the shell and *as the square of its velocity.* The British have always favored a heavier shell and lower velocities than we have, with the result that while the total weight of their broadsides is greater, the respective total energies for the two fleets are about the same, with a slight advantage in our favor.

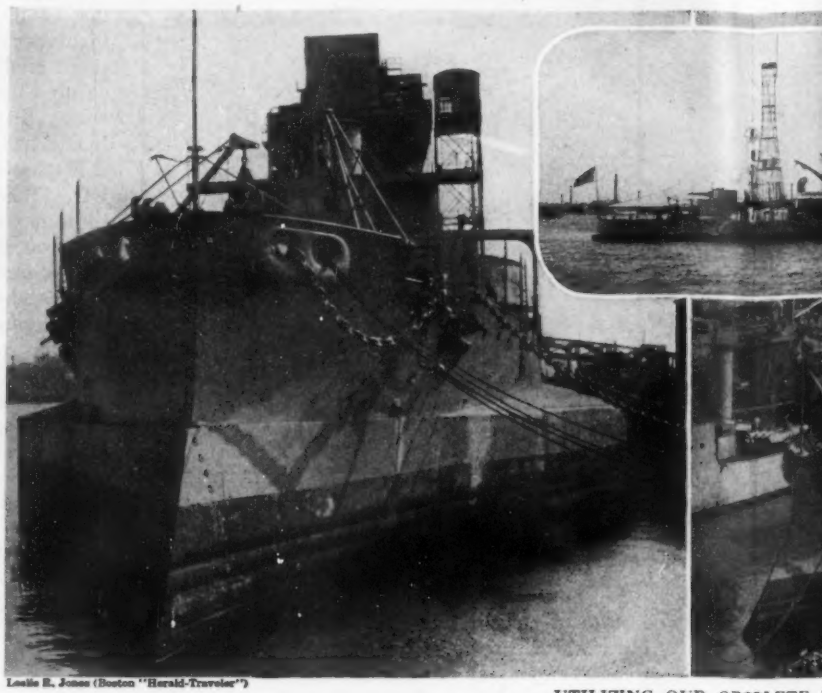
From the Scrap-book of Science—Cam



Pacific and Atlantic Photos

C. FRANCIS JENKINS PREDICTS RADIO MOTION PICTURES

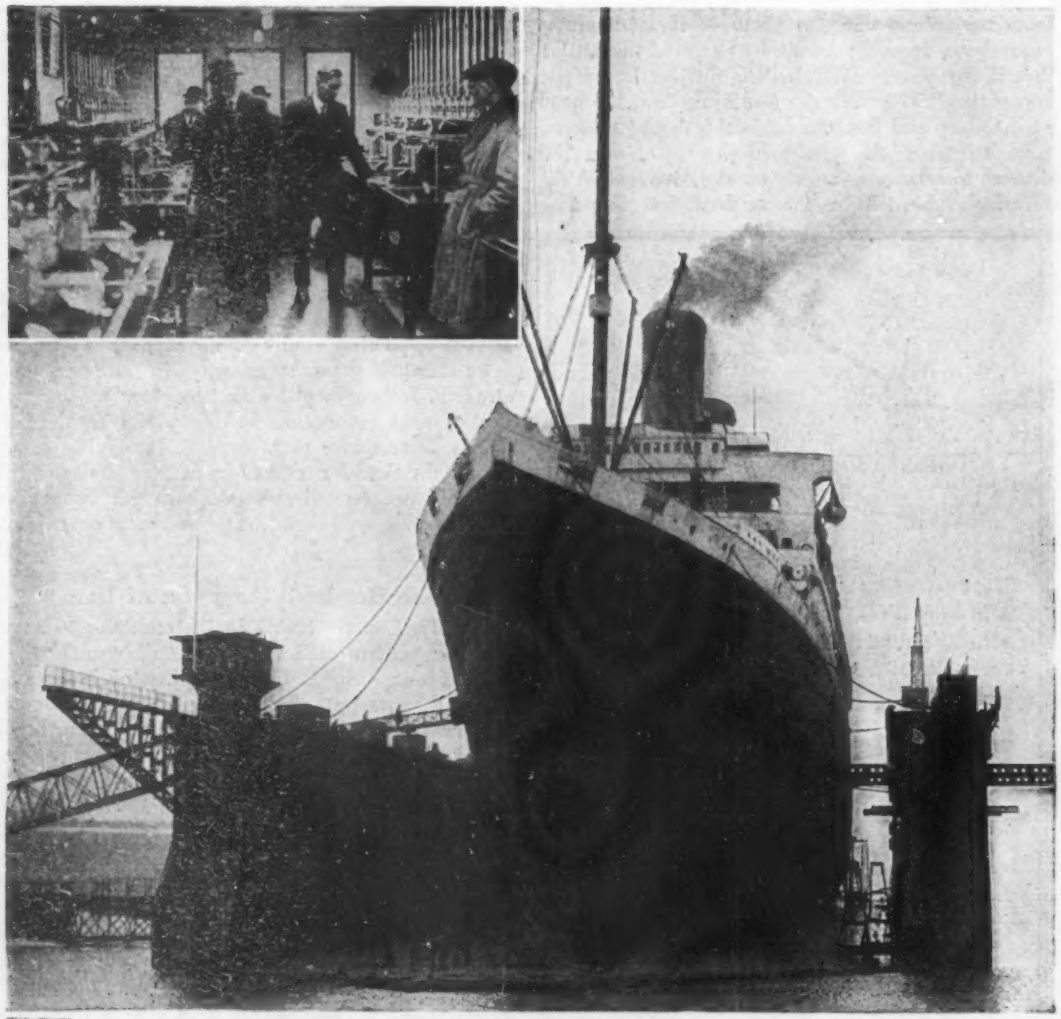
This Washington inventor recently demonstrated apparatus by which moving objects were transmitted through the air and received five miles away on a miniature moving picture screen. He believes that the day will come when broadcast entertainers and speakers will be seen at the same time they are heard in homes throughout the country. He claims that radio will send colored pictures so that all the color of a broadcast scene will be reproduced at the receiving end



Louis R. Jones (Boston "Herald-Traveler")

UTILIZING OUR OBSOLETE

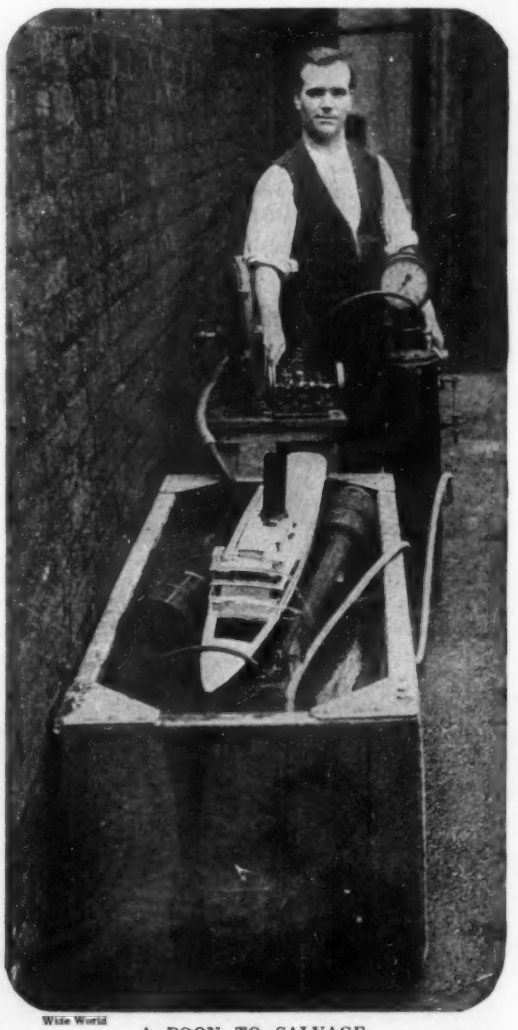
Pride of the United States Navy once, now the largest and strongest floating crane in the world when she was the pride of our Navy. Note th



Wide World

LIFTING A 56,000-TON LINER

One of the world's greatest engineering feats was accomplished at Southampton when the large liner, the Majestic, *was drydocked. By pressing a button, 74,000 tons of iron and steel was put into motion and the 56,000-ton vessel was successfully docked. The dock consists of a huge steel pontoon, over 1,000 feet long, along each side of which is a lofty, vertical, hollow chamber, containing the elaborate system of pumps and operating machinery. The dock is sunk and the ship moved in. Then the water is pumped out, lifting her clear. Insert: Mr. Reah (at the left) who was in charge of the control house on the floating dock is shown at work on some of the numerous valves*

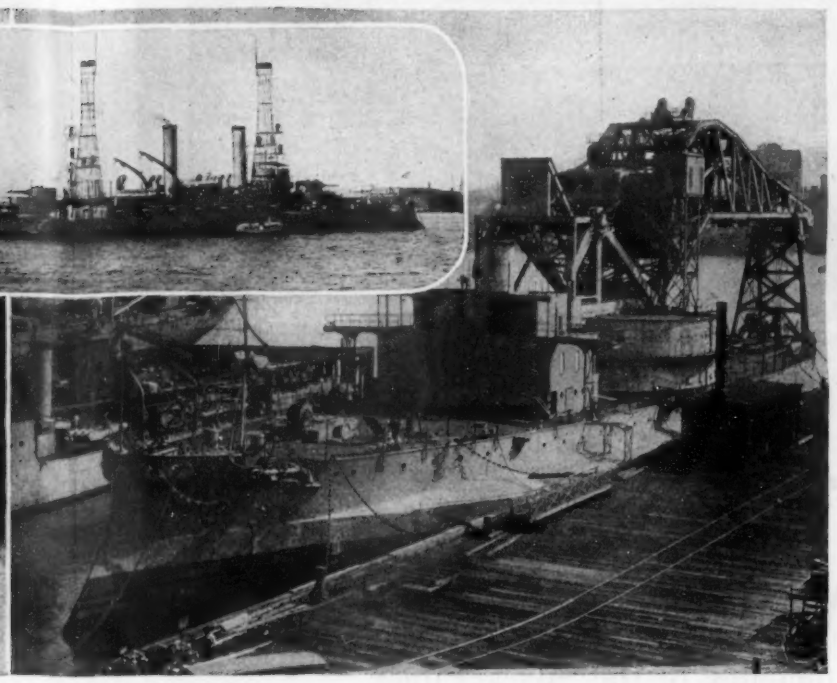


Wide World

A BOON TO SALVAGE

A riveter of Sunderland, England, has just patented an apparatus by which any sized sunken vessel can be raised to the surface at an extremely low cost. The inventor (shown giving a demonstration with his six-foot model steamer) states that by his method he could raise a ship like the Lusitania *at a cost of under three hundred dollars.*

Camera Shots of Scientific Happenings



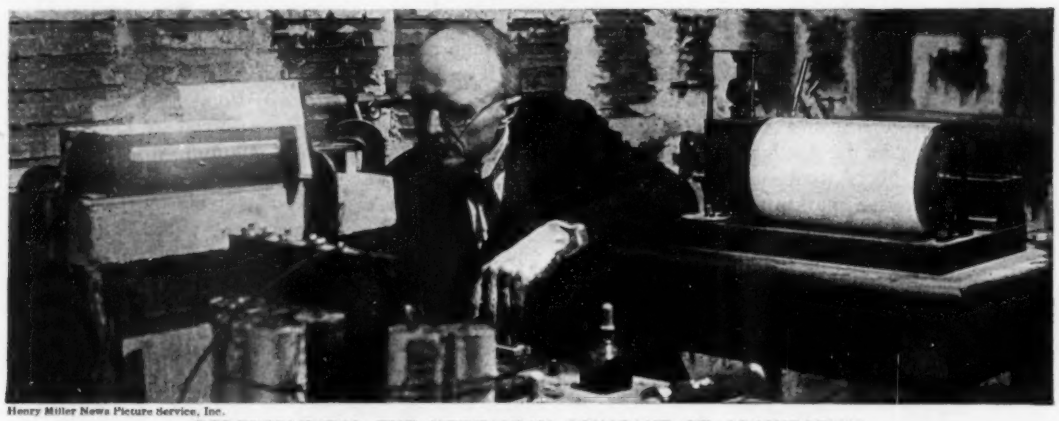
UR OBSOLETE BATTLESHIPS

crane in the world—U.S.S. Kearsarge *now at Charleston Navy Yard. Insert—Thirty years ago ur Navy. Note the pontoons built on the sides*

Wide World

REDUCING DANGERS AT SEA

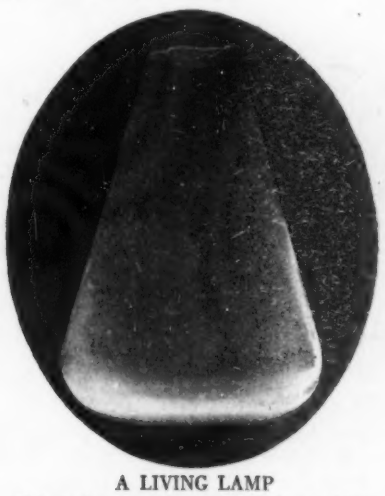
This lifeboat is propelled by hand instead of by gas. It has levers fitted at the thwarts, the boat is got under way by moving the levers to and fro thereby driving the screw. The advantages are that the boat can be got away from the ship's side immediately also that only one trained seaman need be in the boat, no experience being necessary to work the levers



Henry Miller News Picture Service, Inc.

REDETERMINING THE NEWTONIAN CONSTANT OF GRAVITATION

In a subterranean dugout, twenty-five feet below the basement floor of the Bureau of Standards at Washington, D. C., Dr. Paul R. Heyl, a government physicist is redetermining the earth's constant of gravitation, already long known, but not known accurately enough to satisfy science. As a by-product of this lengthy and delicate experiment, the mass of the earth, previously known to be about 5,000,000,000,000,000,000,000 tons, can be still more accurately determined. From the earth's constant of gravitation the masses of the sun and planets may be calculated.



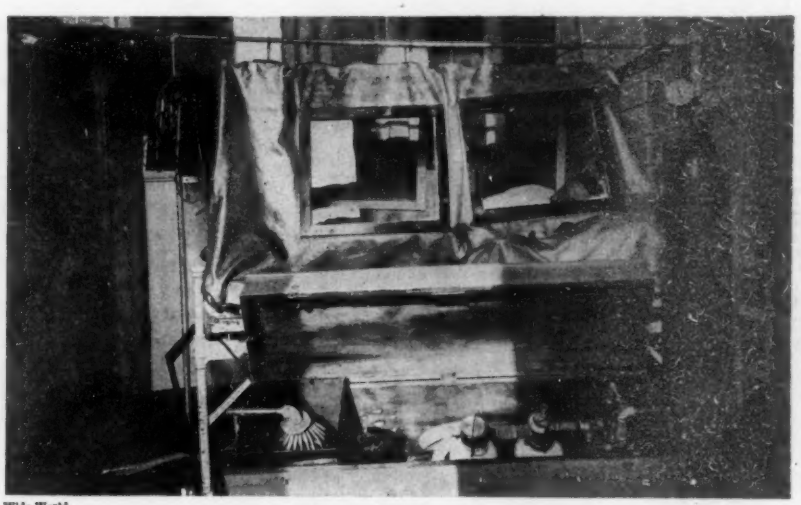
A LIVING LAMP

This beaker contains a pure culture of bacteria that give off cold light. It was photographed, in fact, by its own light which is said to be strong enough to recognize objects in its immediate neighborhood. Man has not yet learned the secret of cold light

Pacific and Atlantic Photos

MACHINE CHEWS BEEF

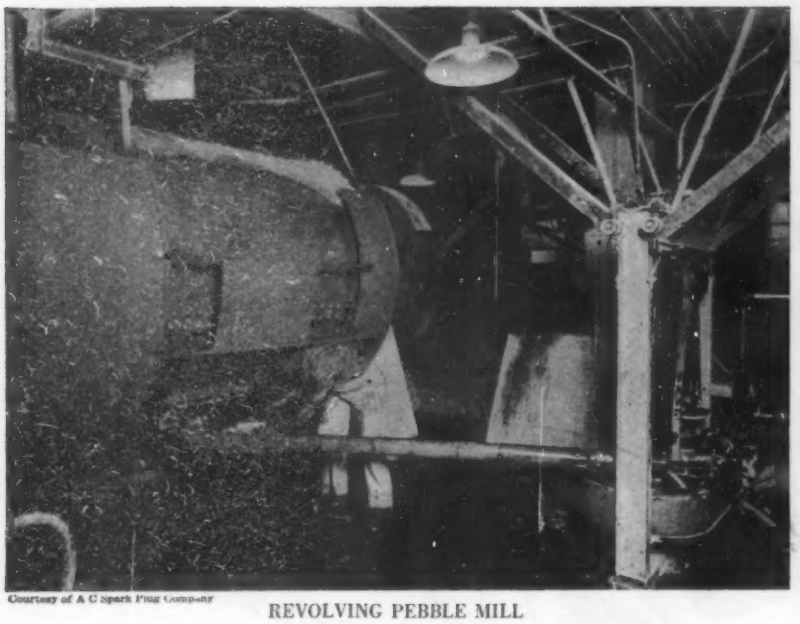
Paul H. Nickel, scientist at the United States Bureau of Standards, seen with the machine which chews the toughest beef to fix its status for table use The beef chewing process is carried on to find out just how tough a piece of beef might become. Experts are measuring the tensile and torsional strains of beef fibers with special instruments.



Wide World

A PORTABLE OXYGEN TENT FOR PNEUMONIA PATIENTS

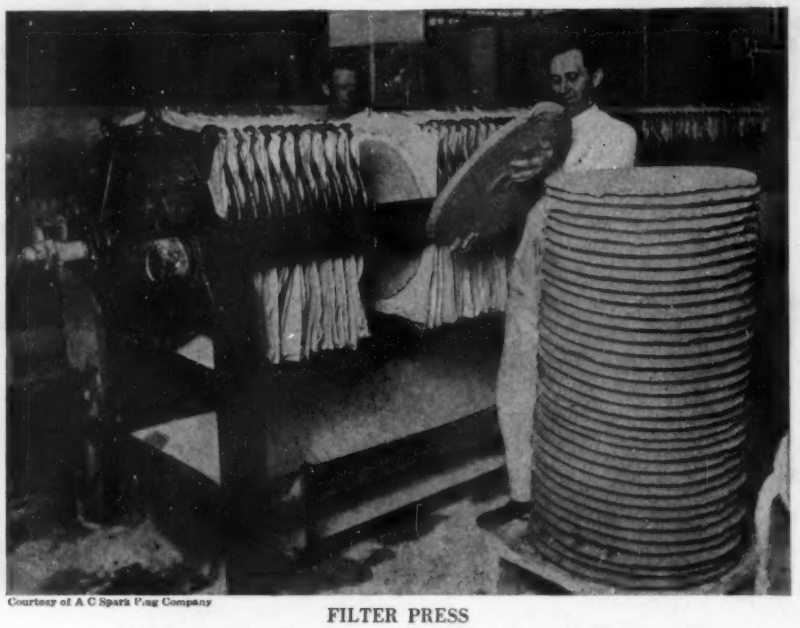
Dr. Alvan L. Barach, of the Presbyterian Hospital staff and Dr. Carl A. L. Binger, of the Rockefeller Institute, have devised this tent of balloon cloth. It has four windows. By means of a circuit or box ventilating outfit, the patient is enabled to breathe an uninterrupted supply of atmosphere rich in oxygen.



Courtesy of A C Spark Plug Company

REVOLVING PEBBLE MILL

Clay is passed over an electro-magnet to remove any traces of iron



Courtesy of A C Spark Plug Company

FILTER PRESS

In this press part of the water is forced out, leaving the clay-like putty

The Life Spark of Motordom

Cars of High and Low Degree Bow to the Efficiency of the Spark Plug

By Channing Patten

LIKE many other important and vital things that are so familiar they become commonplace, combustion in gas engines is now taken for granted. No one, for example, gives much thought to such a thing as a spark plug. The motorist buys gasoline and has it put in the fuel tank of his car; he steps on the starter and expects that the comforting purr of regular explosions will follow as a matter of course. What makes the gasoline explode and drive the pistons on the power stroke? The passage of a spark between the two electrodes of a spark plug performs this important function. And in order that the spark may pass properly and that it may be delivered to the proper place, an infinite amount of careful study has been necessary.

About 1896, the French manufacturer de Dion brought out a spark plug that became immediately popular. It had been made possible by the availability of the dry battery and the induction coil, which produced a high tension current that could be maintained or interrupted at will developing a spark of sufficient size and intensity to ignite the explosive charge in the combustion chamber.

The de Dion plugs were made on specifications that govern European spark plugs today. The plugs of 1925 and those of 1896 share the same fundamentals. They are all made with a metal shell, an insulator, center and side electrodes and an established spark-gap.

Forty Thousand Holes to the Square Inch

From the beginning, spark plugs functioned satisfactorily and it was several years before it was necessary to consider any improvement. Motors then operated at low speed, with low compression, and ran fairly cool in temperature. The porcelain used in the insulator was of about the same grade as that of ordinary dishware. With the development of higher speed motors and higher compression, engine temperatures increased materially and more efficient spark plugs, especially with regard to insulators, became essential.

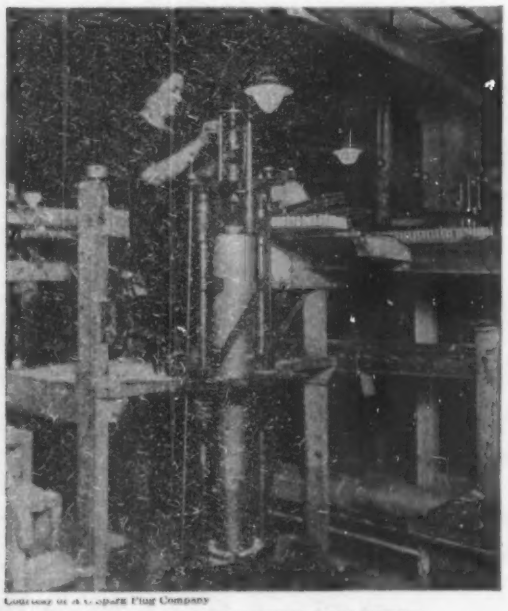
As a typical example of the inception and growth of this industry, it is interesting to note that in 1899, Albert Champion came to America and six years later organized a company for the manufacture of spark plugs. Beginnings were on a very modest scale. The initial volume of business was modest, too, while the production capacity now is in excess of 200,000 plugs daily.

This production involves the use of much ingenious machinery, most of which has been designed and built in the factory itself. The selection, control, treatment and assembly of raw materials form an elaborate and interesting system of manufacture.

Let us begin with the manufacture of the porcelain. The various clays received as mined are placed in storage bins. Batches, consisting of a quantity of each kind of clay, are weighed and delivered to revolving pebble mills where they are mixed together with water to form a slush of about the consistency of cream. This slush is sieved through a screen having 40,000 holes to the square inch and is afterwards passed over an electro-magnet to remove any traces of iron.

This cleaned clay is then forced by motor-driven pumps through filter presses where part of the water is forced through canvas cloths leaving only water enough in the clay to make it plastic, or of about the same consistency as common putty. These cakes of clay as they come from the clay presses are wedged or kneaded, much as is bread dough, on large kneading machines which pass a circular ribbon of clay first under the pressure of a heavy horizontal roller and then between two oppositely placed vertical rollers. The clay, when removed from these kneading machines, has an extremely fine texture.

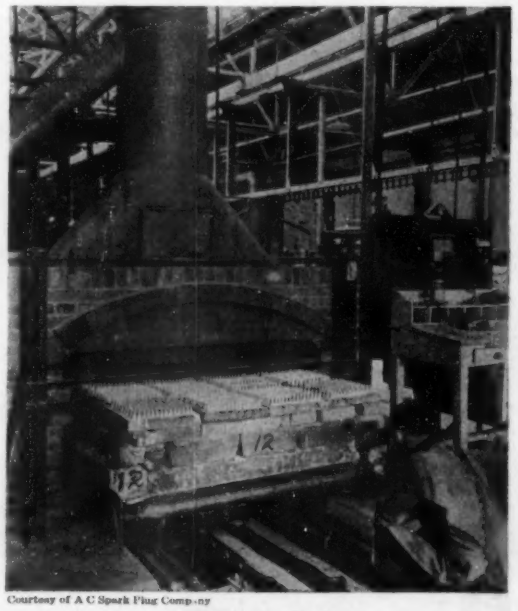
The kneaded clay is then placed in steel cylinders and placed on what is called a throwing machine



Courtesy of A C Spark Plug Company

PORCELAIN THROWING MACHINE

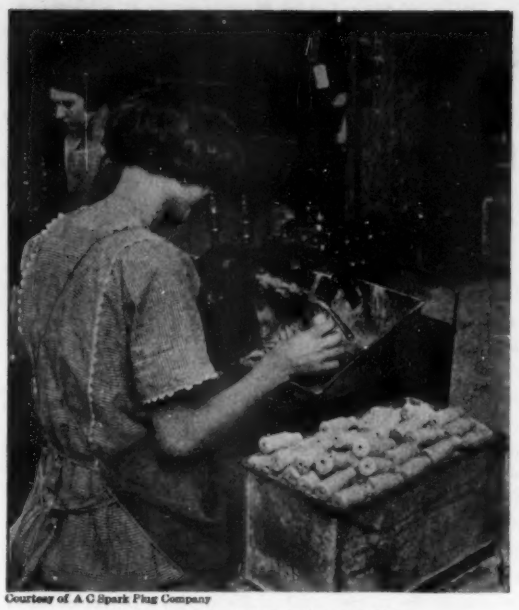
The first shaping and the center hole are made by forcing the clay through a small orifice



Courtesy of A C Spark Plug Company

TUNNEL KILN

Two thousand seven hundred and eighty degrees of heat bake the insulation into permanent form



Courtesy of A C Spark Plug Company

PORCELAIN TURNING LATHE

The finished shape is accomplished by this machine

from which the clay is forced by a plunger through a small orifice slightly larger in diameter than the finished insulator shape. The hole which is to take the center-wire electrode is punched into the clay blank at this point. Before passing to the next operation, it is necessary to remove enough water to stiffen the clay from a putty-like condition to one in which it may be easily cut with a knife. This is accomplished by means of a special dryer which removes an equal amount of water from each blank.

These "leather-hard" blanks are placed on the revolving spindle of a specially constructed turning lathe. A knife comes forward, cutting the finished shape from the cylindrical blank form.

The insulator shapes are next dried to bone dryness, immediately after which the trademark is stenciled on. This mark, being infusible, remains unchanged through the firing which follows, and shows through the transparent glossy glaze which is sprayed over it.

The glossy glaze coating is only a few thousandths of an inch thick. It is composed of minerals mixed so that they melt to a glass and leave a smoothly finished transparent coat on the porcelain.

The insulators, after having the glaze sprayed on them, are set in refractory fire-clay trays, which are in turn placed on flat decked cars that pass through a tunnel kiln, 90 feet long, for firing. A temperature of 2,780 degrees, Fahrenheit, the highest temperature to which any insulating material is being fired, is maintained in the middle portion of this tunnel. The farther the insulators progress into the tunnel, the hotter they become until at the center, they receive the maximum temperature. From this point, they are gradually cooled to room temperatures. This firing process takes 15 hours from the time they enter the tunnel kiln until they emerge.

This firing or baking of the porcelain causes some of the insulator ingredients to fuse and to take into solution some of the other more refractory components. The fact that the refractory portion is in preponderance prevents actual deformation of the piece into a molten puddle.

To make a complete plug there are required: porcelain insulator, already described in detail; one-piece cold-rolled steel shell; copper gaskets at the top and bottom of the plug placed between the shell and the porcelain; a center wire, of nickel alloy which is welded to the threaded upper steel portion, or terminal screw; a side electrode; a terminal nut, and a vulcanized asbestos gasket for insertion between the porcelain and the top shoulder of the terminal screw.

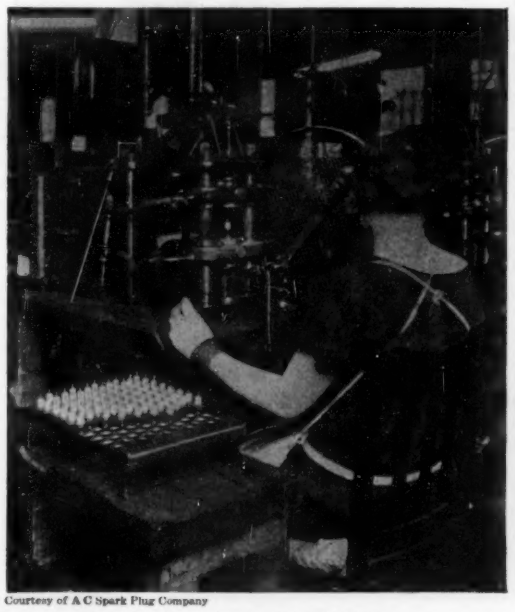
The fabrication of the one-piece shell from a bar of hexagonal cold-rolled steel is a matter of the application of those highly specialized multiple-operation automatic machines that have been developed in connection with the modern industry. The shell is formed and bored and cut to proper length in a few seconds.

Power presses with multiple dies turn out copper gaskets with the same business-like dispatch. The center-wire screw is formed by the heading process and threaded on high-speed roll threaders. The side electrode comes in the form of wire, and is cut to the proper length, and electrically welded to the spark plug body or shell.

Courtesy of A C Spark Plug Company

STENCIL AND GLAZING MACHINE

A trademark is stenciled and a glaze sprayed over it



Courtesy of A C Spark Plug Company

FINAL ASSEMBLY WELDER

Now assembled, the plug is electrically welded into a compact unit

In assembling, the lower gasket is inserted in the steel shell, then the porcelain, then the upper gasket. Both gaskets are pressed into their seats by a special press which at the same time crimps over the top flange on the steel shell to grip the units securely together. Then the plug goes to an assembly welding machine fitted with an electric transformer. The bottom of the plug rests on a metallic seat, forming one pole; a die comes over the top of the plug, forming the other pole and completing an electric circuit.

A pressure of 4,500 pounds to the square inch is applied while the electric current passes through the shell and brings the grooved section to a red heat. The shell is thus made plastic by the heat, causing the assembly pressure to be evenly distributed and insuring perfect alinement without any strain on the insulator core. Being assembled at a higher temperature than ever attained in any motor, subsequent expansion of the metal shell in service cannot loosen its tense steel grip on the insulator core, thus preventing compression leakage.

Long experimentation preceded the establishment of the method used to make the center electrode a part of the assembly. If this electrode were merely inserted into a hole in the porcelain and made dependent on cement or a nut to keep the connection gas-tight, failure would be probable, because as the electrode elongated under the influence of heat, the perfection of fit, such as it was, would be destroyed. The plug has the porcelain threaded, and this calls for remarkable precision in manufacture.

Courtesy of A C Spark Plug Company

PACKING THE FINISHED PRODUCT

Finished and ready for packing, a final inspection assures perfection of manufacture

In making the thread, allowance must be made for the fact that porcelain shrinks considerably during the kiln firing. It is, of course, essential that the thread is the exact size for carrying the center electrode, when the porcelain has passed through the kiln. The center electrode, then, is screwed into the fired porcelain, and the tightness of the fit is aided by the use of a coating of cement between. After inserting the center electrode, the assembly is baked for several days in a slow heat, hardening the cement and making the parts a practical unit.

Four Years of Experimentation

Four years were devoted to perfecting a method of electrically welding the side electrode to the steel shell. This is now done by a specially constructed side wire welding machine which cuts the side wire, welds it to the shell and then automatically ejects it and greatly bettered thermal contact results. Tests show that heat flows away twice as easily through a welded joint as it does through one drilled in the steel shell with an electrode inserted and swedged into place. This is because of the perfect thermal contact between the welded electrode and the steel shell, resulting in the heat flowing readily from the electrode to the steel shell and thence to the water-cooled cylinder.

Another very interesting piece of welding is done between the cold-rolled steel top of the center electrode and the nickel alloy wire that forms the center sparking point.

After the side electrode has been bent at a right angle, so that its end reaches the proper distance from the end of the center electrode, the spark plug is completed.

Insect Parasites of Insects

The Story of How Nature Provides Against the Over Propagation of Species and of How the Larva of the Fly Feeds Upon Caterpillars and Other Insects

By S. F. Aaron

Drawings by the Author

ALTHOUGH naturalists do not possess data concerning the life histories of all animals and plants, they have learned so much with regard to the economy of species that it is fair to assert that no life exists without some check being put upon its propagation. And these deterrent influences commonly result from the predacious tendencies of other species often very remotely related, as, for example, the insects and insectivorous vertebrates, or more widely still, vegetation and insects. The natural checks often belong to the same class and even to allied families and genera, as hawks and pigeons, shrikes and sparrows, the rapacious grasshopper mouse and its meeker kindred, the assassin bugs and plant bugs and the fungous diseases of plants.

Many of these natural checks to the multiplication of species have come about through long and complicated development, as, for example, the analid internal parasites of many species, but none are more remarkable than the strange life cycles of the parasitic insects that live on or in other six-legged kinds, and it is safe to say that hardly any species of arthropod exists that is not troubled with "smaller fleas to bite 'em."

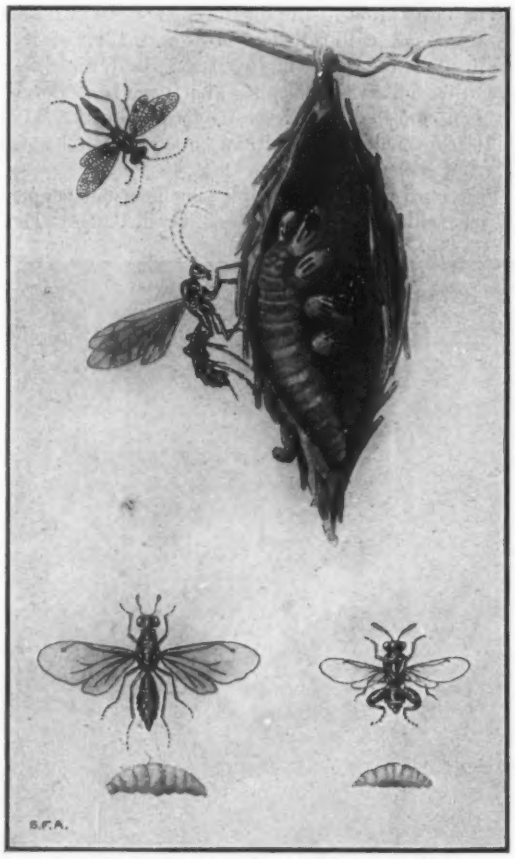
The Caterpillar Plays Host

Difficulty of observation has prevented the recording of deadly parasitic infestation of many species of insects theoretically known to suffer such check to their numbers. Fungous diseases of insects and predatory vertebrate and invertebrate enemies are large factors, but it may be stated that many four-winged (hymenopterous) flies and certain two-winged (dipterous) flies play by far the largest part in determining the limitation of many species, chief among which are the always well-fed and fat larvae of such vegetable eaters as butterfly and moth caterpillars and those of certain beetles and wasps.

The habits of the hymenopterous parasites are all similar, even though they belong to four distinct families. The female by means of a piercing ovipositor deposits an egg or eggs within the body of its specifically chosen victim, which has very aptly been given the name of "host," and the maggot-like larva, hatching, feeds on the insides of the poor caterpillar, not touching its digestive or locomotory organs until the last, so that the host goes on feeding and crawling about slowly to reach its food, though with decreasing vitality, eventually dying, but often not until it has spun a cocoon and passed into an aborted pupal stage. The larva of the parasite then uses the dead body of its victim either as an outer cocoon, spinning another of silk within it, or it emerges and makes a cocoon outside, either loosely adhering to the host, possibly to drop off later, or to grass stalks close by.

Where many eggs are deposited within the same host, as is the case with a large number of the smaller parasitic species, the infested and rapidly dying caterpillar becomes decorated with a quantity of tiny, adhering, silken cocoons which, under the microscope, resemble closely in shape and color the several hundred times larger (cubically) cocoons of the domestic silkworm of the Orient. These tiny pupal cases may be observed most often on the body of the big green tomato and tobacco sphynx worms, the caterpillar of the humming-bird hawk moth, on the closely related larva of the grape-vine sphinx worm and on the body of the green caterpillar of the white cabbage butterfly, one of the cabbage worms. Many other allied species of moths and butterflies are thus infested; they are not always distinctly injurious species, but often so, and thus they have come to be considered as highly beneficial.

Many of the parasitic adult wasps are quite large and these belong to the true *Ichneumonidae*, the family also containing some small forms. Those species of the *Brachonidae* are either of medium size or very small; the *Chalcididae* is represented by



PARASITES OF THE BAG-WORM AND HYPERPARASITES

Upper left: Ichneumon *fly, the larvae of which, after feeding on the worm, build the small cocoons shown inside the cut open bag cocoon. Center: Another* Ichneumon *fly that with its ovipositor pierces the bag, its larva developing and pupating with the body of the worm or its chrysalis, as shown. Lower left: A* Brachonid *secondary parasite fly and its larva which too often destroys the primary parasite larvae. Lower right: A very small* Chalcid *fly and its larva which is a secondary or ternary parasite, infesting cocoons containing both the primary and secondary parasites shown as well as infesting other species*

stout-bodied little flies, generally with thick posterior legs and the family *Proctotrupidae* are nearly all quite tiny and slender-bodied. This latter group has among its numbers insects that parasitize the eggs of spiders, larger flies and moths. They are more active and swifter of wing than their similarly minded cousins and because of this they are less observed, although perhaps not rarer.

It may be said that nearly all of the larger and medium-sized parasitic wasps insert but one egg in each host, no matter how comparatively large the latter may be. An occasional exception is the common big yellow *Ichneumon* fly that infests the caterpillar of the tiger swallow-tailed butterfly and its close relative the spice bush *Papilio*. These fat green larvae, resting lengthwise within a half curled leaf, possess peculiar Y-shaped scent organs that are used in defense against all kinds of enemies, often with complete effectiveness. But the wasp is very frequently persistent so that the caterpillar gets an egg thrust under its skin, no matter how it swings its head around with the forked, yellow, smelly tubes protruding from its occiput. And as though to clinch the matter and prove its own determination the wasp may return to the attack.

From several specimens of these caterpillars in my possession two of the wasps have emerged; they found food enough in the fat worm and did not interfere with each other, though it might be easily imagined that one or the other would turn cannibal if the quarters were too small and the supply of food very limited.

The Most Wonderful Drill in the World

Two *Ichneumon* flies, each about half an inch long with black body and red legs, the species very aptly named conquisitor and inquisitor, commonly parasitize the web-worms, bag-worms and the tussock moth caterpillars—insects frequently observed injuring our shade trees. This process of infection begins when the caterpillars are not more than quarter grown and it is a welcome sight, even though a cruel one, to see one of these wasps very deliberately walking about among the squirming members of a caterpillar colony and sticking her ovipositor into one after another of the defoliators. In this manner some sixty out of seventy web-worms become the hosts of these voracious maggots.

In like manner some small *Brachonid* flies of several species known generically as *Apenteles, Microgaster* and *Praon*, the latter name phonetically at least quite appropriate, infest several kinds of aphids or plant lice, especially those found on apple, cherry, pear and quince trees, rose bushes, peonies and melon vines. Some forms of these parasitic larvae when full grown emerge downward and build a cocoon beneath the body of the dead aphid, which has had its insides completely converted from homopterous to hymenopterous possibilities; others do not emerge until they become adult wasps and make the inflated, dried body of the aphid the parasite's cocoon. It is species of both *Microgaster* and *Apenteles* that infest the tomato and allied worms before mentioned, but in numbers or colonies.

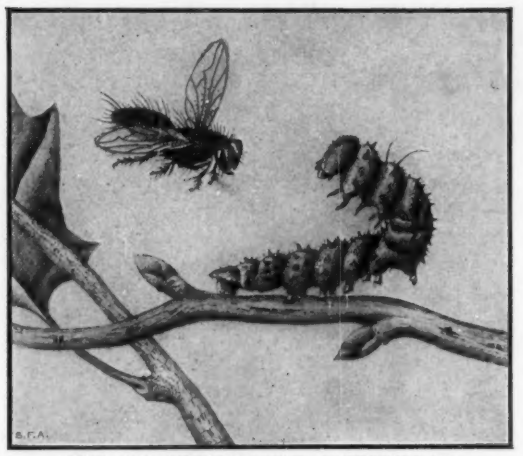
The highly specialized development of the ovipositors of the wood-boring *Ichneumons* is worthy of admiration. So well are these drills adapted that no wood-boring larva of beetle, moth or horn-fly is exempt from infestation if its presence in tree trunk is discovered. The giant black *Thalessa* operates "the most wonderful drill in the world," boring with its slender ovipositor no larger in diameter than a common pin, as flexible as a horse hair and four inches in length into the hardest wood to reach the tunnels of its victims. Another species, much smaller, bores into the dried and seasoned branches of the oak tree. Descriptions of the habits of these destructive insects have been given by the writer in a past issue of the Scientific American.

We cannot include all of the parasitic *Hymenoptera* among the beneficial insects; some of them, and probably a far greater number than our limited studies lead us even to imagine, parasitize beneficial species and other insect parasites of insects. The before mentioned destroyers of the eggs of spiders are to be included, for spiders are, of all creatures, probably the most useful to man. There are also parasites of carnivorous beetles and their larvae, assassin bugs in all stages, and digger wasps which destroy grasshoppers and caterpillars; some of these, however, along with the frequently infested mason wasps, also destroy spiders. And we hardly know how these parasitic creatures stand as a class in relation to man's interests, when we consider closely the habits of the so-called hyperparasites.

As but one typical illustration, we may consider the case of the very common and destructive fall web-worm, an almost universal feeder that would eat everything green and growing from the face of the earth, were it not for its numerous enemies; birds, insects and spiders, the latter playing the most important rôle as balancer. The persistent bag-worm affords another example.

Competition Among Parasites

The little white millers of the fall web-worm seem never very plentiful, but there are enough of them to lay countless thousands of eggs in every locality from which are hatched numerous colonies of the ugly web makers on the terminal branches of many kinds of trees and bushes. But at once the enemies get busy, and among them are several kinds of small four-winged flies—primary parasites. Few of the caterpillar colonies are missed; often many are thus destroyed. More often the worms greatly outnumber the egg capacities of the little wasps. Cocoon masses of these parasites may be seen in nearly every web, many or few, and these vary with the different species. Some are squarish oblong, white with short brown longitudinal stripes or dashes around the middle; others are larger and cream-colored. Most remarkable are those of dull yellow



THE FLY ATTACKS THE CATERPILLAR

A Tachinid *(dipterous) fly attacking a young (lepidopterous) caterpillar. If not driven off by the squirming worm, the fly's eggs will be fastened to the outside of segments generally near the head of the caterpillar*

hanging on a long silken thread often outside of or within a more open part of the web.

If these fellows were left alone, there would be a very limited number of web-worms. But even more common than the unhampered stages are to be found those that in turn have been parasitized by their cousins or more distant relatives.

There are numerous very tiny hymenopterous flies that lay their eggs in the infested worms and these, hatching first, destroy the young larvae of the first interlopers. Other species lay their eggs directly within the cocoons of the primary parasites. They are so small that four or five of their larvae may occupy an infested cocoon not over three-sixteenths of an inch long. Each of them spins a fine lining of silk within the thicker container of the victim.

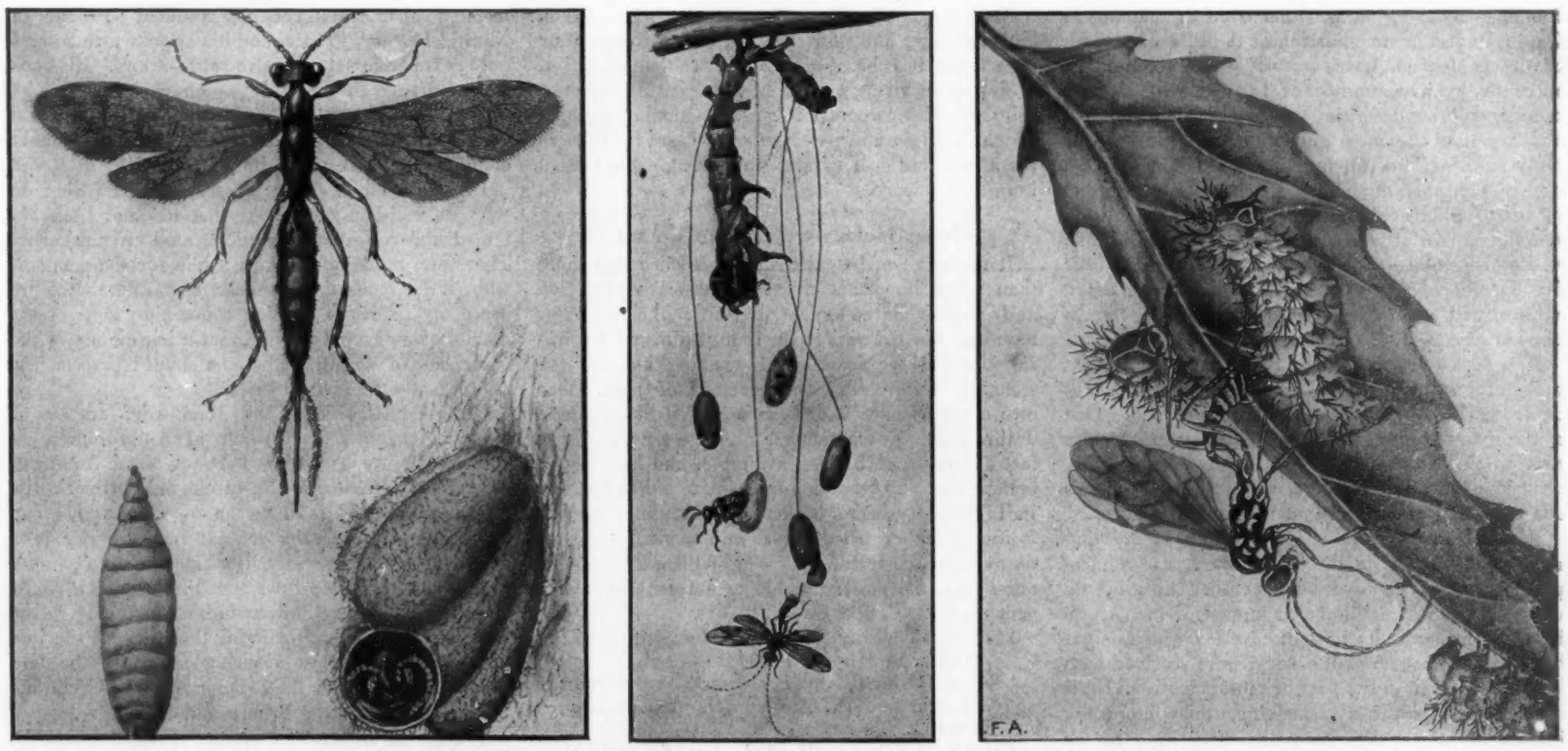
This hyperparasitism of the secondary parasites is very common and naturally considered detrimental to man's interest, but it does not end here. There are, in turn, ternary parasites: tiny creatures, also, that in much the same manner as practiced by the group at large, inflict their presence upon the secondary parasites, generally the cocoons of the primary parasites being attacked, and it is simply a case of the most rapid development, the latter fellows usually getting the better of it, though sometimes the larvae of the primary or secondary parasites may destroy those of the third dynasty of interlopers.

A Horrible Struggle for Existence

Thus we have a complication of circumstances which characterizes in the most horrible manner the struggle for existence, and except to the systematic student of species, it is quite impossible to completely separate the many good from the bad actors in this tragic drama of "I'll eat you or you'll eat me."

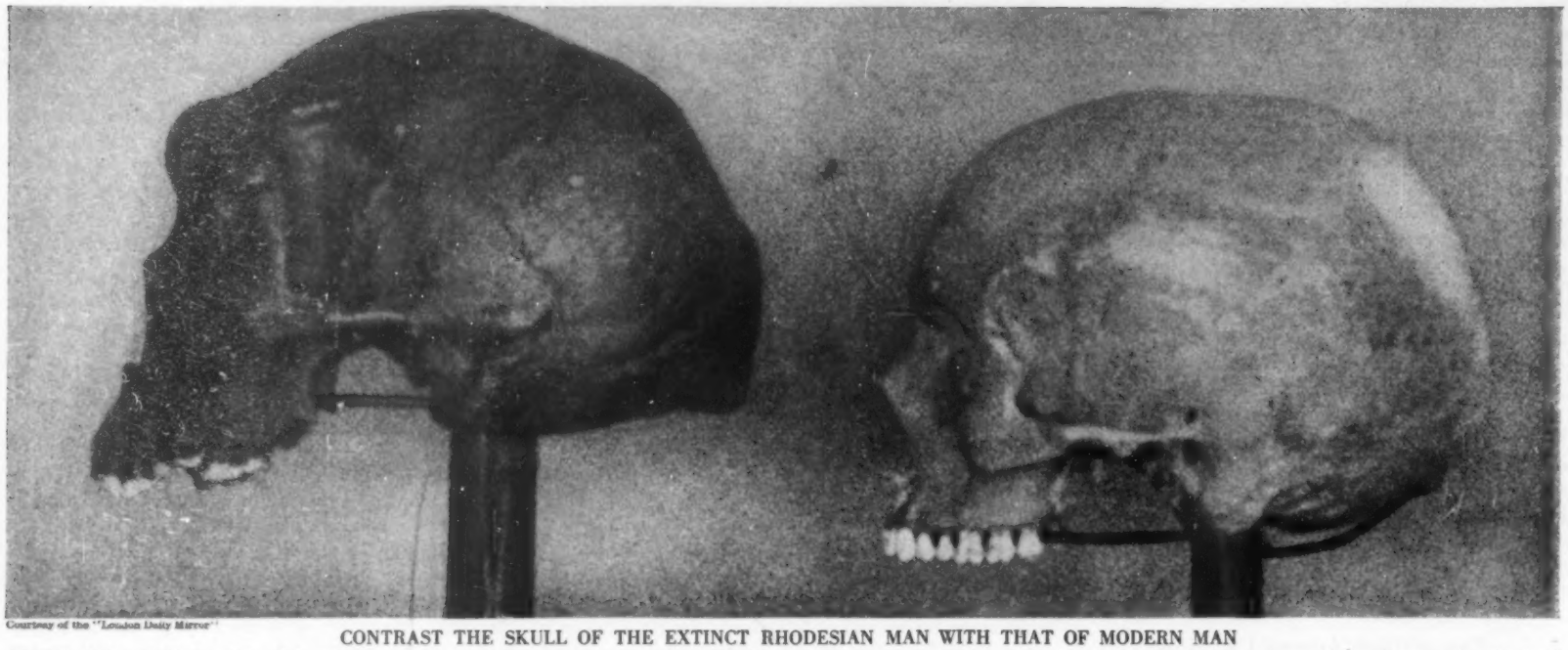
The parasitic *Diptera* do not in any case known insert their eggs within the body of the host, but attach them to the outside, most often near the head, and firmly enough to keep from being dislodged by any activities of the caterpillars or other insects infested until the eggs hatch. These tiny maggots very quickly and at once bore through the skin of the host, living thereafter much as do the hymenopterous larval guests. The inactive stage, invariably a mahogany colored, elliptical puparium, is generally transformed outside of the infested insect, in some few cases within, should the caterpillar quickly die. But in the many instances observed by the writer fatality from *Tachina* larvae parasitism is much slower and even not so sure, for very frequently the infested creature goes through its transformations in the pupal stage. Nor is tachinid infestation nearly so common as that of the *Ichneumons;* this is clearly indicated by the parasitized caterpillars taken by the collector for rearing and by winter-gathered cocoons.

Out of fifty cocoons of the big emperor moths (the cecropia, polyphemus, prometheus, io and imported cynthia), an average of thirty-five or forty infested by hymenopterous parasites of three or four species is usual, with perhaps four or five *Tachina* parasites.



PICTURES WHICH SHOW JUST HOW THE *ICHNEUMON* FLY PARASITIZES ITS VICTIMS

LEFT: *A common* Ichneumon *fly that parasitizes bag-worms, web-worms and other caterpillars of leaf-eating* Lepidoptera; *(upper) the adult fly—black with red legs; (lower left) the cream-colored larva; (lower right) the cream-colored cocoons, with the end of one cut open showing the fully developed fly about to emerge.* CENTER: *A caterpillar killed by the larvae of an* Ichneumon *fly; the cocoons of the parasites; an adult fly escaping from a cocoon by neatly cutting out one end; a secondary parasite fly* (Chalcid) *emerging from the side of an* Ichneumon *cocoon.* RIGHT: *An* Ichneumon *parasite fly laying an egg in the body of a young caterpillar of the io moth. From thirty to fifty worms may be infested by one fly*



Courtesy of the "London Daily Mirror"

CONTRAST THE SKULL OF THE EXTINCT RHODESIAN MAN WITH THAT OF MODERN MAN

The Rhodesian skull, found in Africa in 1921, gives us for the first time, says the anatomist, Sir Arthur Keith, a glimpse of something like our own ancestral state in Pliocene times, hundreds of thousands of years ago. Though the skull is large outside, it is twice as thick as that of modern man, the brain being both small in size and primitive in quality. Note the extreme vertical length of the face, the immense eyebrow ridges, the retreating forehead, the enormously strong jaw and large teeth. In the teeth are ten large cavities, and at their roots are plain evidences that the original owner of this skull suffered with severe toothache, for abscesses had formed and broken.

New Light on Evolving Man

Recent Events Have Given the Science of Man's Evolution a New Impetus

By Albert G. Ingalls

MAN'S evolution has been traced by his actual fossil remains to about the beginning of the glacial period, half a million years ago or thereabout; but evidence is now accumulating to prove that human culture is very much more ancient, even, than this. Some crude chipped implements of stone, fashioned by races of men that lived in England in the dimly distant time horizon of the Pliocene Epoch of the geologists, have recently been accepted as authentic by a committee of learned men internationally representing the science of anthropology, and are thus *the most ancient known evidence of early man.* If we can find the fossil bones of the men who chipped these flints, we shall have a definite record of what evolving man looked like a million years ago. An article written by Mr. J. Reid Moir, an English anthropologist who is chiefly responsible for our knowledge of this earliest known human culture, will appear in a coming issue of the Scientific American.

It is beginning to look as if some of the ancient races of our own type of man did not, after all, differ markedly from the modern European. One of the men of Chellean times, at least 100,000 years ago, would, according to Sir Arthur Keith, easily pass in a crowd in modern England, so little has our own race evolved in that vast length of time.

We still see the several known types of evolving man quite dimly, as through a haze, for anthropology as a science is yet but a youth. Only seventy years ago almost nothing was known of man's prehistoric past and the new discoveries which might have then told some of the story, were received with incredulity even on the part of most scientists. Until recently, comparatively speaking, this interesting branch of science has been almost entirely in the hands of a few devotees.

In America, no previous book has received as much popular attention as that accorded to Professor Fairfield Osborn's "Men of the Old Stone Age," first published in 1915. That book captured the interest of men and women of all vocations—people whose life interests had lain far from the supposedly esoteric field of anthropology—and taught them intelligently to follow and to interpret the now frequent newspaper despatches announcing new fossil finds of early man.

Thus the public has at last become interested in anthropology; and now that Mr. Bryan's opposition to science has been giving the whole subject of evolution an airing and is thereby exciting the curiosity of millions concerning the particular question of man's origin and past, the stage is set in America for a new and still greater popular impetus to that branch of science.

New Books on Prehistoric Man

It might, then, be called a coincidence that more than seven important treatises on man's evolution and culture have appeared within the last few months. These works have simply followed a growing demand for readable, interesting but not too technical information on the story of man. Our own evenings have long been occupied in the pleasurable reading of a number of these new works as fast as they have become available, and because we believe that our readers are as interested in keeping well abreast of the newer scientific books as in following other scientific developments, we have now chosen the following seven of them as being, in our belief, the most valuable to the general intelligent reader.

"Fossil Men," by Professor Marcellin Boule (Oliver and Boyd, 1923)

"Human Origins," by Professor George Grant MacCurdy (D. Appleton and Company, 1924)

"Man's Life on Earth," by Samuel C. Schmucker, Ph.D. (The Macmillan Company, 1925)

"The Antiquity of Man," by Sir Arthur Keith (J. B. Lippincott and Company, 1925)

"Fossil Man in Spain," by Professor Hugo Obermaier (Yale University Press, 1924)

"Ancient Hunters," by Professor W. J. Sollas (The Macmillan Company, 1924)

"Prehistory," by M. C. Burkitt, M.A. (The Macmillan Company, 1925)

Professor Boule, author of "Fossil Men," is a member of the staff of the National Museum of Natural History, France, and his approach to anthropology is perhaps the most versatile of any. His book treats early man not only as an evolving animal, but as the creator of a culture and as a world wanderer; in short, "Fossil Men" is a thoroughly comprehensive treatise. Boule is lucid.

Professor Boule is a conservative, refusing to treat as valid any evidence that has not been obtained under absolutely authenticated circumstances. Therefore, his book is a safe guide for the amateur, who, if he reads more widely, will find that there are many shades of opinion concerning some of the details of anthropology and that a knowledge of the consensus of scientific thought should precede the reading of attractive theories.

Professor George Grant MacCurdy, author of "Human Origins," is Curator of Anthropology at Yale University, as well as Director of the American School of Prehistoric Research in Europe. His "Human Origins" is the type of work which can be recommended to the general reader, since it is comprehensive, profusely illustrated and contains a plain, straightforward account of what we know about man's culture and evolution, beginning in the Age of Mammals and bringing the story all the way up to modern times, covering not only the Old Stone Age, but the New Stone Age or Neolithic Period, as well as the Bronze and Iron Ages.

Just as the manuscript of this review goes to the printer a new book entitled, "Man's Life on Earth," by Dr. Samuel C. Schmucker, has been issued. This book is the most elementary of the group and because it answers in simpler, plainer language and

in more naïve manner than any book of the sort with which we are familiar the frequent requests which we receive for "a book that tells what it is all about," we have added it to our list. Such a work has long been needed and it is certain that its readers will follow to the reading of other books on the same subject with greatly enhanced comprehension of anthropology because of it.

Professor Sollas' "Ancient Hunters" is the enlarged third edition of a well-known work. It lays particular stress on the attractive but now somewhat discredited theory that there is a relation between certain ancient and certain modern types of man, such as, for example, between the Magdalenians of about fifteen thousand years ago and the modern Eskimos. This work ought to be read only in the light of considerable reading in anthropology, in order that the reader may previously have developed a sense of proportion concerning the validity of its theory.

Fossils Clothed with Life and Humaness

M. C. Burkitt, of Oxford University, is the author of "Prehistory," a revised edition of a former work which is devoted rather one-sidedly to ancient man's flint implements. Some of the chapters, notably the one on man in relation to geology, are remarkably lucid, while others are rather abstruse.

"Fossil Man in Spain," by Professor Obermaier, has a misleading title, for the subject matter covers fossil man in all Europe, together with his culture, especially his cave art and his implements as brought to light in Spain, largely by the author. This work is the first English translation of an older work which appeared in Spanish. The language is extremely vivid and clear, the subject matter is fairly general and the book is well illustrated.

Lastly, the seven hundred pages of Sir Arthur Keith's "The Antiquity of Man" are almost wholly devoted to the analysis of the actual fossils of ancient man, the author being Professor of Anatomy at the Royal College of Surgeons of England.

Personally, we have enjoyed the study of "The Antiquity of Man" in its new, rewritten edition more than any one book of the seven under review. It is believed that the great majority of anthropologists would gladly accord to Keith the position of foremost physical or anatomical anthropologist of the world. He takes us on a sort of anthropological ramble over most of the earth in each of the time periods of man's evolution, beginning with Neolithic Man and proceeding further and further back in time. Let the reader who anticipates that the study of fossil bones will be dry, read this remarkable work, whose author clothes the dusty bones of our primitive ancestors with life and humanness, his manner of approach being almost conversational.

Courtesy of the "Illustrated London News"

NOT ANCESTRAL TO MAN, SAYS KEITH

Professor Dart's new reconstruction of Australopithecus, *the South African man-ape described in our May issue*

Sir Arthur Keith devotes a chapter to an interesting account answering the familiar and often incredulous query, "How can they build up a whole skull accurately from three or four of its fragments?" As a test, four fragments were cut from a peculiar type of complete modern skull and were presented to Sir Arthur. These fragments were cut to correspond in outline with the four original fragments from which the Piltdown skull was reconstructed. Here was a fair test problem for the modern anatomist-anthropologist.

Sir Arthur spent two days at work on the four small pieces and then displayed the almost perfectly reconstructed skull, which, it was then told him, was that of an Egyptian woman. "Guesswork" does not enter into such work, but it is done on the basis of certain definite laws of craniology.

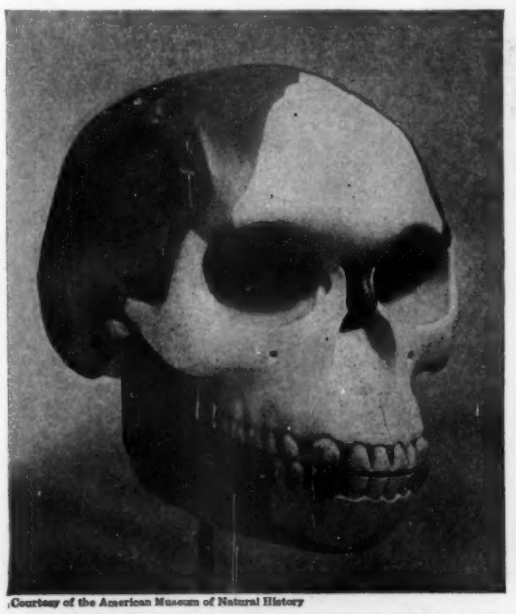
What of ancient man in America? Although there has been but one find of fossils other than those of Indians, that being the molar tooth of *Hesperopithecus,* a mid-Pliocene anthropoid ape found in Nebraska, the fossils and stone implements found long ago at Trenton, New Jersey, as well as the Vero, Florida, skeletons, the Lansing, Missouri, skeleton, and the Long's Hill, Nebraska, skeletons being simply those of American Indians, the latter are nevertheless of Pleistocene (glacial) Age and this indicates very strongly that man had reached the western world by 10,000 years ago, and probably very much earlier. It is thus evident, says Sir Arthur Keith, that the American Indian had evolved from mongoloid stock long previous to that date, a conclusion opposing that of ethnology.

Science Extending the Antiquity of Man

How and when did the three great races of man originate? The common ancestor of the European, the African and the Mongolian was very much like the modern Australian aborigine, who, like the modern monkeys and anthropoid apes, has retained most of his early characters and is thus a sort of "living fossil" brought down to us from 200,000 years or more ago. Thus it has required 8,000 generations for man to differentiate into the present races. The pure-blood negro of central Africa is, however, a more recent special product which split off about 100,000 years ago from the negroid stem, which lacked many of the negro's more specialized characters and was not so dark as the negro.

Neanderthal man was a much more ancient product, and was an entirely different species of *Homo* from modern man. His branch of the family tree split off before the middle of the Pliocene Epoch, the epoch before the glacial period. This was at least 350,000 years ago. Modern man, that is, *Homo sapiens,* which term includes all the living races, is evidently extremely ancient, much more so than science had supposed, argues Keith, who on the other hand, assumes considerably smaller time estimates for the various epochs than most other scientists, believing that there has been too much of a tendency to overestimate the length of some of them, particularly the glacial period.

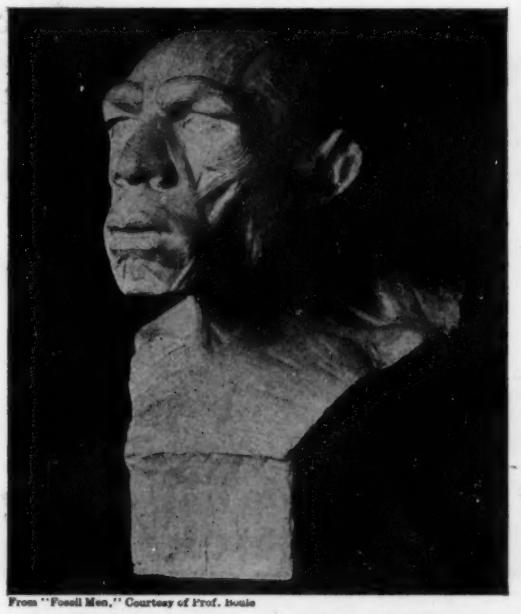
What of the future? So far, says Sir Arthur, we have probably discovered but a few fossil twigs of the great evolutionary human tree, which must have carried a welter of fossil forms of man from which only one type has survived until today.



Courtesy of the American Museum of Natural History

OUR EARLIEST SPECIMEN OF TRUE HUMANITY

The Piltdown man saw, heard, felt, thought and dreamt 200,000 years ago, much as we do, says Sir Arthur Keith, who emphasizes man's antiquity



From "Fossil Men," Courtesy of Prof. Boule

THE CAVE MAN, 40,000 YEARS AGO

A reconstruction based on the skull shown at the right, made by M. Joanny-Durand, a French sculptor-anatomist. Neanderthal man was primitive, but not unintelligent

Courtesy of the American Museum of Natural History

NEANDERTHAL MAN, AN EXTINCT SPECIES

We have many skulls and sketches of Neanderthal man, some of which are virtually complete. He was not ancestral to our races, but was a collateral or side branch

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

Conducted by Albert A. Hopkins

A house on stilts

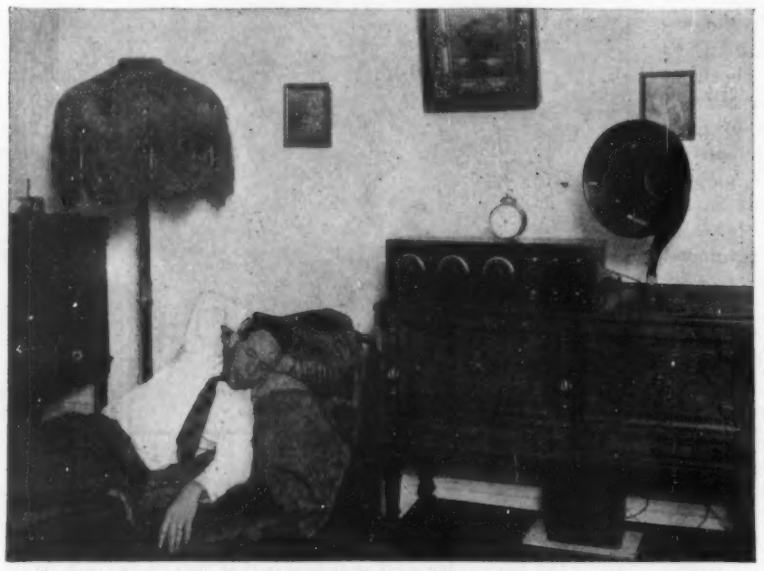
Doing Away with the Retaining Wall

ALONG upper Riverside Drive or along Amsterdam Avenue at Fort George, one sees many odd looking apartment houses which appear to be built on stilts. It has been found that a steel framework to support the superstructure is more economical than to build heavy, stone retaining walls as was formerly the custom. As houses erected on a steel framework are exposed to wind pressure, allowance is made for this.

A Steel Brush for Kitchen Work

HERE is a rustproof steel wire brush that cleans kitchen utensils with great thoroughness and its usefulness is not limited to the kitchen proper. It really needs no extended description.

A wire brush for the kitchen



Radio time switch for automatically switching the batteries on and off

A New Use for an Alarm Clock

AN ordinary alarm clock may do the work of shutting off or starting your radio set at any desired time.

The main operating mechanism for the radio control is an arm projecting slightly from the bottom of the clock which draws inwardly at the time set. It causes the contact to break on the "A" battery.

Electric Wringer

THERE are now on the market several types of electric wringers which are mounted on a frame that can be moved anywhere around the kitchen or laundry. This is a great improvement over the old hand wringer. Our illustration shows an excellent type. The motor can be connected to any outlet.

Ford cars on rails

Portable electric wringer

Ford Charabanc on Rails

ON one English railway, on a branch where the traffic is light, two Ford cars have been connected back to back with a special body and metal wheels. The driver can use the mechanism on either car according to the direction in which he is going. Our illustration shows two cars at a station.

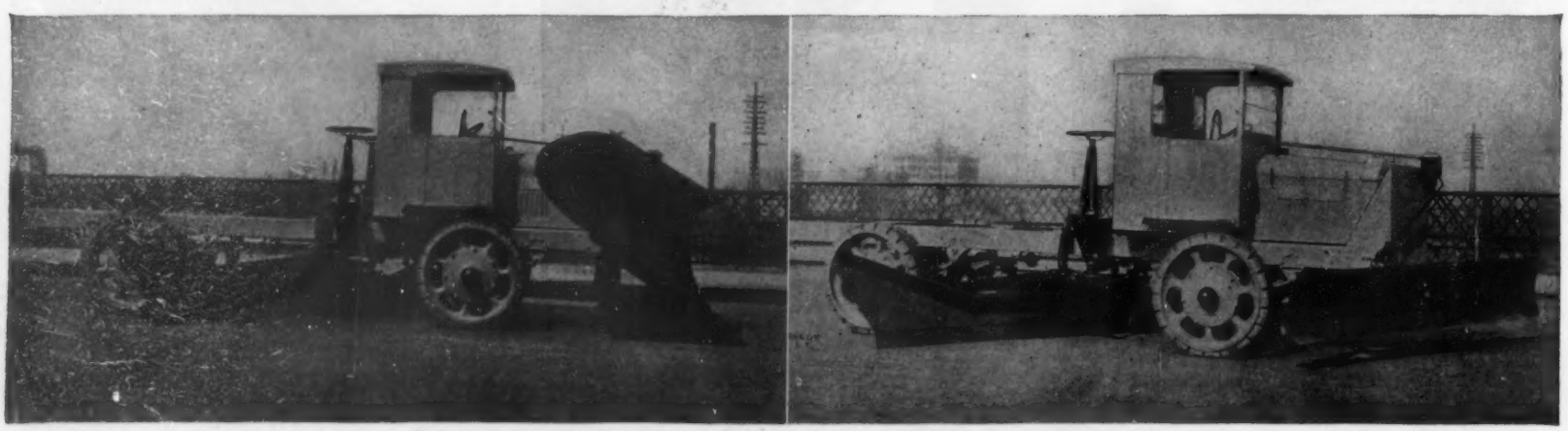
Moving Snow in Two Stages

IN the snow-plow tractor which we illustrate, the snow is removed in two stages. The front plow being used to remove the high snow and the center scraper plow being used to level off the road and scrape down to the road surface if desired.

A Universal Service Spoon

THE service spoon illustrated here can be used for serving food on the table if desired. It is broad and sharp on the edge. It gets under food for turning.

A service spoon with manifold uses

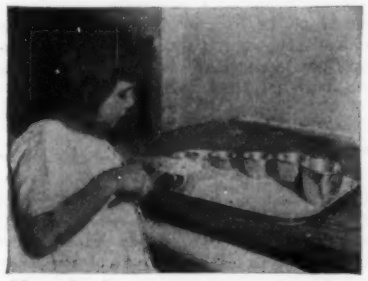


A tractor snow plow equipped with two blades is very efficient in snow removal

Window washing and painting made safe

A Novel Safety Device

FALLS from windows during the process of cleaning them or when hanging out clothes are frequently fatal. The safety device illustrated here is in the form of a seat similar to that used in the common swing for children. It is held in place by chains attached to the window frame, and when in position, is on a level with the window sill. A strong back strap snaps from one chain to the other. It is also used by painters to stand upon while painting a window frame.

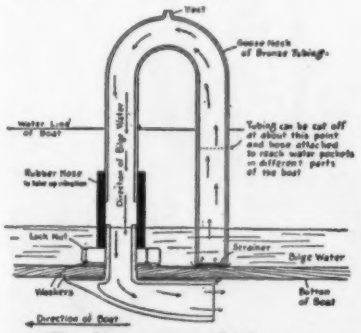


Mary Ann's accurate measuring cups

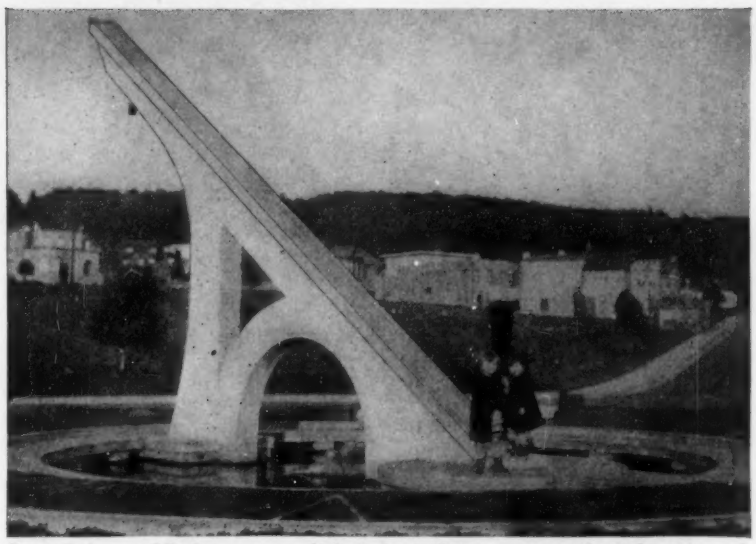
Paradoxical Bilge Bailer

IF you provide a speedboat with an underwater port opening astern you will be saved the backaches of pumping bilge water. Such automatic suction ports are usually provided with checkvalves in order to prevent the hull from refilling as soon as the boat stops moving. Checkvalves, however, are often a nuisance. A bit of rag or any trifle suffices to hold open the flap. The boat slowly fills, and sinks.

To obviate this risk, Mr. Gar Wood of Detroit, replaces the bothersome checkvalve with a simple gooseneck of piping, rising above the outside water level. In order to prevent outside water from syphoning back into the boat when it lies at anchor he bores a venthole in the top of the gooseneck. This selfsame vent ought to prevent the very sucking action of the bailer that is most desired! Mr. Wood admits that it ought to do this, theoretically; but he finds that in practice the thing works despite the vent and the adverse theory.


Vent
Gooseneck of Bronze Tubing
Water Line of Boat
Direction of Bilge Water
Tubing can be cut off at about this point and hose attached to reach water pockets in different parts of the boat
Rubber Hose to take up vibration
Lock Nut
Strainer
Bilge Water
Washers
Bottom of Boat
Direction of Boat

The boat pump which saves your back



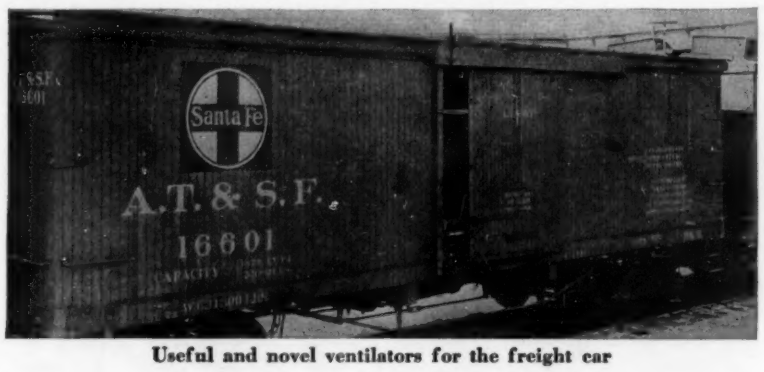
One of the world's largest sun dials is located in a new residential section of San Francisco, California. An idea of the immense size of the sun dial may be gained by comparison with the children in the foreground

What Is a "Cupful"?

UNTIL a few years ago nobody knew definitely; now the Bureau of Standards has established the size of a "cup" or rather its capacity. In the set of aluminum cups shown we have a quarter cup, a third cup, a half cup, two-thirds of a cup, three-quarters of a cup and a standard cup. Thus guesswork is eliminated.

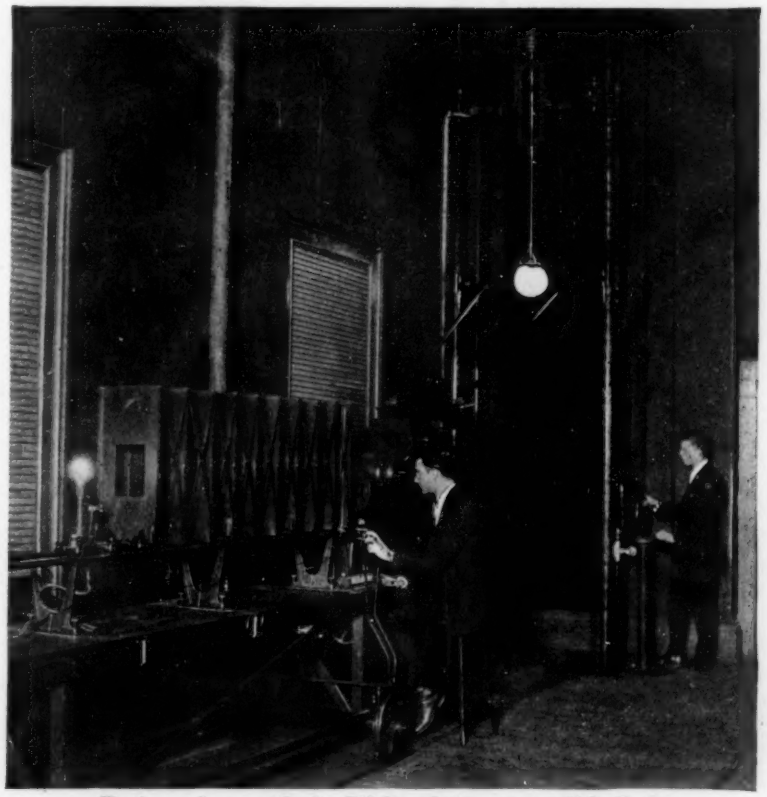
A Ventilator for the Box Car

IN this device, when a box car is to be ventilated the screen is inserted as shown taking up part of the space that would be normally occupied by the door.



Useful and novel ventilators for the freight car

When used as a permanent fixture, it is fastened to the car by two U-bolts which act as hinges. The locking bar in the center, which is the same length as the width of the screen, is used as a keeper to lock the screen back to the door when out of service. It is also used to lock the door when the screen is inserted in the door as a ventilator; this is sealed in the ordinary way employed in sealing box-car doors. When closed, there is a loop at the top and bottom edge of the screen, into which the door fits; this holds it solid when in position, and makes it impossible to break in or out without destroying the seal.



Testing a lamp with the Dibdin photometer at Nela Park

Another use for the window shelf

One Brush for Three

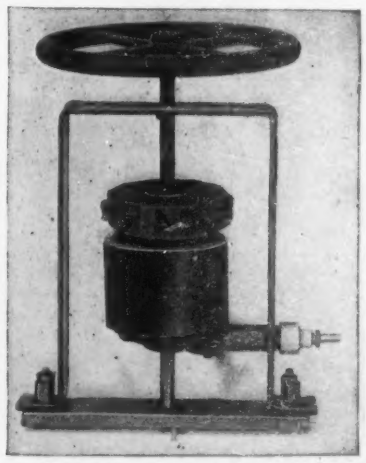
THE designer of the brush illustrated has made a study of what is needed in one brush to do the work that heretofore required the work of two or three. To clean a typewriter three different kinds of brushes have been necessary. This one brush combines one of soft camel's hair for cleaning between the keys, type rods or under the carriage. It also includes a very bristle brush for cleaning type and, in addition, a specially designed brush to reach places hard to get at.

The brush is protected at all points by rubber so it will not scratch the machine.

Making one brush do the work of three

Branding the Storage Battery

STORAGE batteries are often stolen or lost. A Philadelphia manufacturer has designed a rotary branding machine so that the batteries may be stamped with the dealer's name. The batteries may also be numbered so they can be accounted for.



Brand your storage battery

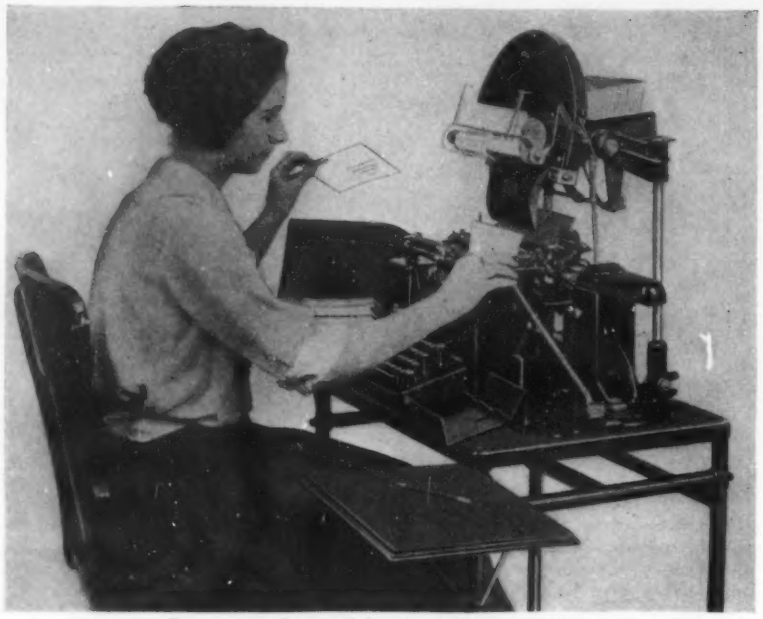
A splendid physical experiment—the Foucault pendulum

Foucault Pendulum at Washington

STANDING at constant attention before the massive Lincoln Memorial, in Washington, is the new building of the National Academy of Science and the National Research Council. This structure provides headquarters for the two important scientific bodies whose name it carries, but its actual role goes far beyond this service. It is designed primarily as a means of keeping the general public in intimate and comprehensive touch with the march of science and the progress of research.

Even in the construction of the new temple of science the latest developments in various fields of investigation have been applied. As an example, the acoustics in the spacious auditorium in this building afford an extraordinary contrast with "the hall of a million murmurs," the dome room of the Capitol building. Standing at one side of the latter and whispering across the big open space, one gets the echo hurled back into one's ears indiscriminately from all quarters. Repeat the test in the auditorium of the National Academy building, and the low tone of the voice is carried without confusion from one end to the other. This result is achieved through the use of a new wall-building material known as acoustalithic brick.

Another of the popular features of the new building is the elaborate apparatus for the Foucault pendulum experiment, showing the earth's diurnal rotation. A heavy brass ball is suspended as a pendulum, by means of a long wire. As the earth whirls about its axis, the pendulum holds to its original plane in space, and to the earth-bound eye the path through which it swings seems to rotate slowly, covering a complete circle in twenty-four hours.

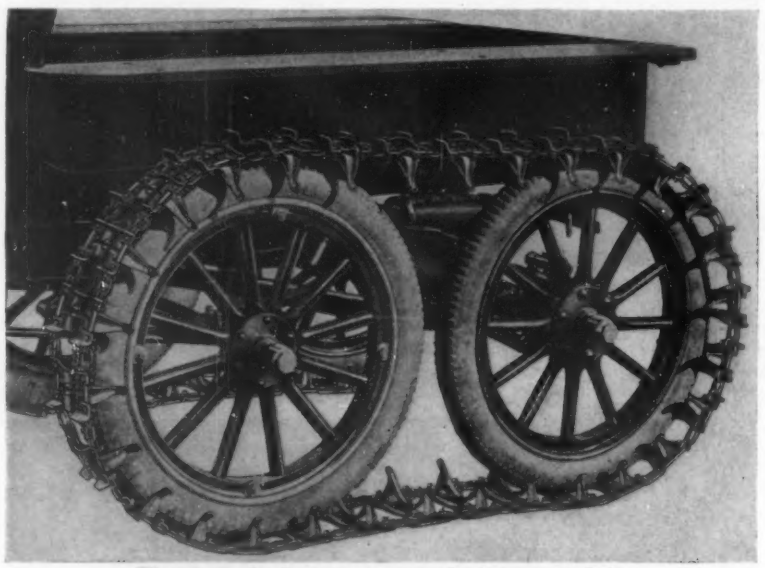


Increasing the usefulness of the typewriter

Snowshoeing the Motorcar

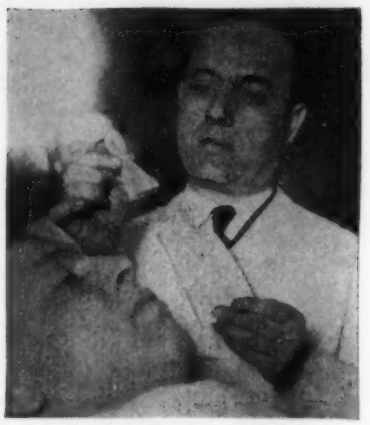
AFTER six years of experiment with "snowshoes for autos," runners to replace front wheels of an auto, and a tractor-like attachment consisting of two sets of rear wheels, have been introduced by an eastern concern, manufacturers of motor sleds.

This device, when attached to an auto, makes it possible for the car to be driven over the bare spots which are so often found on wind-blown winter roads. When used in mud wheels are substituted for the front runners. It is said that an average speed of eighteen miles an hour can be attained over snow-covered roads that might otherwise be impassable.



The extra wheels serve to carry the ice-creeper belt

The "snowmobile" increases the Ford's usefulness



An individual sanitary shaving brush

Speeding Up the Typist

THE "Speed-o-feeder" for addressing and filling in envelopes, forms and invoices, works in connection with any standard typewriter. Its operation is simple, a single motion of a lever being all that is required to move the typewriter carriage to place, turn out the addressed envelope, turn the new envelope to proper position, move the list to the next name and count the addressed envelopes.

A list holder moving automatically keeps the name to be addressed in direct line with the operator's eye. This attachment does not interfere with the ordinary use of the machine.

One to a Customer

THE ever-present danger of contagion from either anthrax germs or other diseases due to shaving brushes in barber shops, is eliminated by the use of individual vegetable fiber brushes. They are contained in sanitary, sealed envelopes and are to be thrown away after using once. It is estimated that each brush costs less than half a cent apiece.

The Ever-upright Bicycle

THIS curious-looking bicycle comes from London. The speed of a bicycle and the safety of a tricycle are both attained. The extra wheels can be raised or lowered at will so as to avoid side slips or when the bicycle is left at rest.

The support is worked by rotating the handle bar, with which it is connected by a cord, and means are provided for instantly fixing the wheels at any desired height. When kept close to the ground, they form a most effective safeguard against falling while the motion is not hindered.

Bicycle or quadricle at will—the extra wheels lowered

The wheels are raised out of the way

Recently Patented Inventions

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

FIREMAN'S HAT. — Of relatively light weight, constructed to protect the head from water, flying embers and the like, and provided with air space. Patent 1539997. A. Fenichel, 4074 Piedmont Ave., Oakland, Cal.

NECKTIE.—Composed of two thicknesses of material of tubular formation, dispensing with padding, and constructed to be conveniently pressed. Patent 1541675. I. D. Wolfson, 16 W. 39th St., New York, N. Y.

Electrical Devices

RHEOSTAT.—Wherein a minimum number of simple parts easily effect a very fine adjustment. Patent 1535898. R. M. Camp, Box 632, Daytona, Fla.

ELECTRIC WELDING DEVICE.—Whereby the arc electrode associated therewith may be maintained at the proper temperature without interfering with a welding operation. Patent 1534688. W. B. Collins, c/o J. L. Fountain, Box 583, Raleigh, N. C.

SIGNAL-SENDING APPARATUS IN WAVE TELEGRAPHY.—By means of high frequency machines based upon the known property of coils with iron cores to be able to vary their inductivity. Patent 1540712. L. Pungs, c/o Dr. F. Warschauer, 111 Gitschiner St., Berlin, S. W. 61, Germany.

ELECTRICAL STETHOSCOPE.—With the vibrating parts so constructed as to be responsive to the heart beats, and non-responsive to any other frequencies of beats. Patent 1540585. R. B. Abbott, 339 Sylvia St., W. Lafayette, Ind.

STAND LAMP.—Which may be readily packed and shipped and moved from place to place in a knock-down condition. Patent 1540773. J. Goldman, 5081 Broadway, Chicago, Ill.

ELECTRIC TOASTER.—With means whereby the toasting operation may be discontinued at a predetermined interval and eliminate burning. Patent 1541711. G. E. Q. Hitzroth, 160 Charlton Ave., Hamilton, Ontario, Canada.

ELECTRICALLY-OPERATED STAMPING DEVICE.—The insertion of an object closing the switch, and the action of the plunger removing the object automatically. Patent 1540168. C. S. Dutton and G. H. Derrick, Oakland, Cal.

DRY-CELL BATTERY.—In which the electrolyte is in paste form which will remain in a state of preservation until put into active use. Patent 1542705. H. M. Koretzky and B. H. Teitelbaum, c/o Bright Star Battery Co., 15th St. and Riverhead, Hoboken, N. J.

CIRCUIT CLOSER. — For road signalling, having means for controlling the duration of the signal. Patent 1542635. C. J. Nyman, 22 Pine St., So. Manchester, Conn.

Of General Interest

CLAMP AND LOCKING DEVICE FOR FORMS FOR CONCRETE CONSTRUCTION.—Designed for use in the forming of wall copings, belt courses, window and door sills on building structures.—Patent 1524050. J. L. Monten and C. Nelson, c/o Carl Nelson, 7214 Langley Ave., Chicago, Ill.

GRAVE MARKER.—All metal, therefor everlasting, will hold a flag securely, makes a grave easy to find; undertaker sets metal letters quickly, constructed ready to place on grave. Patent 1528718. Cecil Wilson, 187 Morris St., Portland, Ore.

DRAIN TABLE.—For use, either to the right or left of a wash tub or sink, adapted to fit various curved edges. Patent 1535928. D. F. Loudon, 109 W. 102nd St., New York, N. Y.

DISPLAY CARTON.—Constructed from a single piece of material, and rendering the contents practically proof against theft. Patent 1535968. R. Van Iderstine, c/o Nevins Church Press, 135 William St., New York, N. Y.

News for Inventors

A Department of Facts and Notes of Interest to Patentees and to Owners of Patent and Trademark Rights

Conducted by Milton Wright

Inventions Cut Costs

THE extent to which inventions cheapen processes of manufacture is indicated by Judge Johnson of the Circuit Court of Appeals in the case of the American Cone and Wafer Company against Denaro.

"One-quarter of all the ice cream cones manufactured in the United States are made on the Bruckman machines," says Judge Johnson, "and the price has been reduced for cones from $15.50 and $17.50 per thousand in 1908 to $3.00 per thousand soon after the Bruckman machine came into use."

LL.D. For Trademark Thesis

COLUMBIA UNIVERSITY in 1922 established a doctorate in law obtainable in course rather than as an honorary degree. Recently the first of these degrees was awarded, its recipient, Frank I. Schechter, taking as his thesis: "Historical Foundations of Trademark Law." It is the first volume of a projected series of "Columbia Legal Studies."

Most writers have assumed the antiquity of trademark rights without going to the trouble of tracing them. Mr. Schechter takes the subject step by step from the earliest known decision touching on the subject (Southern vs. How in 1618) down to litigation over marks in use today. The development of the law of unfair competition with respect to trademarks, he declares, has been hampered by the failure of the law to keep pace with the functional evolution of trademarks themselves.

Mr. Schechter's scholarly work not only gives abundant evidence of thorough research but it is highly interesting. Lawyers and business men having anything to do with trademarks will undoubtedly find it well worth while.

Boyce Laughs Last

THE United States Court of Appeals for the Third District has recently ruled, in harmony with the corresponding court for the Second District, that the Boyce Moto Meter is a real invention. In this case it was attacked by the Pyrene Manufacturing Company. In the previous case the opponent was the Stewart-Warner Speedometer Corporation.

Judge Wooley draws the distinction between what is and what is not an invention. With previous automobile heat registers the thermometer bulb was placed in the water in the radiator; with Boyce's invention the bulb hangs in the air space above the liquid in the radiator. This selection of the air space, the court rules, constitutes the invention.

"The purpose of the device is not to inform the automobile driver how hot the water in the cooling system is," Judge Wooley writes. "For this would mean nothing to the ordinary driver. Its purpose is to inform him that something has happened inside the engine hood so that he may stop and find it before it is too late."

The court remarks incidentally that when the Boyce Motometer first appeared it was regarded as so thoroughly useless that it provoked mirth among automobile egineers. Later it was accepted by the public to the extent of 3,500,000 instruments of a retail sales value of over $20,000,000, and was adopted by manufacturers for regular equipment on 170 makes of automobiles and trucks.

A Caution for Foreign Trademark Owners

TWO large importers, one of plate glass and the other of drugs, were surprised recently to find their goods barred from this country because of failure to comply with all the provisions of a useful but little known feature of trademark protection.

The requirements are found in section 27 of the Trademark Act of 1905 and section 526 of the Tariff Act. These provide that with all imported goods the country of origin must be specified on the goods themselves. In the case of each importer in question the goods were consigned to his customers, who, of course, were not known to the Treasury Department. The goods were properly trademarked, but the country of manufacture, as stated on the containers, was a different country from the one filed with the Treasury Department as the country of manufacture.

The customs officials, thinking the goods spurious, held them up. The explanation was that the one manufacturer had factories in two countries, but valuable time was lost while the papers on file with the Secretary of the Treasury were amended accordingly.

Owners of trademarks, applying to articles manufactured abroad, are finding it advisable to specify to the Secretary of the Treasury all of the localities from which their goods may emanate in order to avoid delay at the Appraisers' Stores.

Six Hundred Hair-curler Patents

EXCAVATORS in an Egyptian tomb recently found a small implement for waving hair. With an art so old, one would think there might be small room for invention. Nevertheless, the Patent Office has issued six hundred patents on new devices for putting a wave or curl in women's tresses.

The first American hair-curling patent was issued to a man named Lewis in 1857 for an iron that could be heated by plunging it into hot water. In 1861 a system was evolved whereby hair was waved by being pressed between hot pieces of wood. Then followed the invention of a metallic tube through which steam was passed, and the hair was wrapped about the tube with resulting curls.

Despite the fact men have been the inventors of most of the hair curlers, it was a woman, Ellen T. Crain, of Kansas City, who, in 1873, patented the first machine for making a "permanent" wave.

Now that bobbed hair has become almost universal the Patent Office is expecting more patent applications than ever in this seemingly narrow, age-old field of invention.

LOUD SPEAKER.—Having a main horn and auxiliary horns whereby the sound waves may be controlled as desired. Patent 1535,951. L. Schwartz, c/o Pacific Silk House, 125 E. 59th St., New York, N. Y.

UMBRELLA.—Having means for reducing wear at the pivotal points of the ribs, thus increasing the life of the frame. Patent 1535993. H. Garfinkel, 36 42nd St., Corona, N. Y.

UNBREAKABLE COMB.—With embedded reinforcing means, through the back and into each of the teeth, of vulcanized rubber or celluloid. Patent 1533330. W. E. Muse, Silt, Colo.

FOOT MEASURE.—Adapted for use in measuring the human foot, compact, of light weight, and constructed of metal. Patent 1535996. W. T. Goldsmith, 391 Mulberry St., Newark, N. J.

LUNCH BOX.—Having compartments for solid and liquid foods, and in which the compartment for solids may be expanded or contracted. Patent 1535954. E. P. Smith, 8 Stout St., Pittston, Pa.

CESSPOOL-WALL CONSTRUCTION. — Which will effectually permit of drainage, at the same time minimize the filling of the cesspool with earth or sand. Patent 1536000. J. H. Hawkins, Sayville, N. Y.

SMOKER'S RECEPTACLE.—With a receiving compartment into which ashes, matches and cigar or cigarette stumps, may be discharged and extinguished. Patent 1535908. J. A. Dolan, 43 Burr Ave., Hempstead, N. Y.

MULTIPLE-EXPOSURE ATTACHMENT FOR CAMERAS.—Allowing several exposures to be made on a single film, the same person being shown in various positions. Patent 1533433. S. C. Linden, 253 3rd St., San Francisco, Calif.

LIFEBOAT DAVIT.—Which may be secured to the deck of a vessel in a substantial manner, for the expeditious lowering of boats. Patent 1534049. S. E. Allbin, c/o Mayer Life Boat Co., 411 Haller Bldg., Seattle, Wash.

SHEATHING BOARD.—By means of which metal lathing can be dispensed with, the construction including a retaining surface for stucco. Patent 1534511. M. F. Frederiksen, 1117 High St., Alameda, Calif.

COMBINED CLAMP AND CONNECTION.—Whereby the leg sections of a tubular steel tower may be firmly and securely clamped, and fastened to each other. Patent 1535342. G. W. Ross, c/o Mrs. Ross, Box 72, Healdton, Okla.

WATERPROOF COVERING FOR CAMERAS.—By means of which under-sea photos may be taken in deep water. Patent 1535312. R. T. Hosking, c/o Pitcher & Co., 401 Eddy Bldg., Saginaw, Mich.

ATTACHMENT FOR PHONOGRAPHS.—Whereby the horn may be utilized for amplifying the sound to a telephone receiver circuit or the like. Patent 1537849. W. J. Madole, 124 Columbia Heights, Brooklyn, N. Y.

SELF-DUMPING SCOW.—Which will obviate the usual cost and delay in unloading material in the water. Patent 1538012. P. Vincent, c/o George Benson, 254 Capital Apts., Olympia, Wash.

CLASP FOR WATCH BRACELETS.—Readily adjustable to present varying widths whereby the clasp may be made to suit any size watch loop. Patent 1538819. J. R. Kay, South Lawrence, Mass.

COMBINED RADIO AND PHONOGRAPH CABINET CONSTRUCTION.—Whereby a common horn can be used to transmit either phonographically produced sounds or radio broadcasting. Patent 1538755. M. Stettner, 318 E. 75th St., New York, N. Y.

BATH-SPONGE DEVICE.—In which the sponge can be readily attached to or detached from a handle. Patent 1538740. C. Petersen, 644 N. Lasalle St., Chicago, Ill.

FINGERPRINT DEVICE.—In which an inking pad and an ink eradicator are housed in

respectively defined compartments of a small case. Patent 1538767. G. H. Watson, Medina, N. Y.

WALL CONSTRUCTION.—Of plastic material without the use of forms or molds, thereby reducing expense. Patent 1538681. W. C. Buckhout, Lincoln Station, Yonkers, N. Y.

LATHERING DEVICE.—Providing a sponge rubber lather spreading element for softening the beard, and a soap receptacle attached. Patent 1538741. G. W. Peterson, U. S. S. *Medusa*, c/o Post Master, San Francisco, Calif.

TURRET FOR SUBMERSIBLE VESSELS, SUITABLE EITHER AS A STEERING HOUSE OR WATER-BALLAST TANK.—In the form of a watertight false turret surrounding the proper turret, and means for permitting water to enter or escape. Patent 1538782. V. De Foe, c/o Mr. Gaetano Capuccio, Via Arsenale N. 17, Turin, Italy.

PORTABLE PHONOGRAPH.—Wherein the tone arm is automatically lowered to an out-of-the-way position when the device is closed. Patent 1538690. S. Davidson, c/o Fulton Talking Machine Co., 253 3rd Ave., New York, N. Y.

CIGAR BOX.—Having a sectional lid, one section of which may be removed for display in a showcase thus saving space. Patent 1539757. R. M. Markland, 7211 3rd Ave., Brooklyn, N. Y.

METHOD OF MAKING SHOES.—Whereby the upper is lasted in upon the slip sole around the heel seat, the remainder being sewn. Patent 1539507. A. H. Prenzel, Halifax, Pa.

MEMORANDUM WRIST WATCH.—Combining with a wrist watch a memorandum device which will constantly be presented to the eye of the wearer. Patent 1539781. A. E. Smythe, 322 Calle Guanahani, Buenos Aires, Argentina.

MOTOR WINDING HANDLE FOR PHONOGRAPHS.—Which may be housed and concealed within the confines of the cabinet. Patent 1539710. J. Zitzerman, 449 Stone Ave., Brooklyn, N. Y.

HEADDRESS.—Adapted to be used by persons wearing their hair cut in the so-called "bobbed" style. Patent 1539706. H. Wallman, 66 Frankonia Ave., Flushing, N. Y.

WINDOW-CLEANER'S SEAT.—Provided with a back rest of a flexible nature, and a limited outward movement. Patent 1539729. A. Gold, 116 E. 119th St., New York, N. Y.

EXERCISING DEVICE.—For building up such parts of the body as may need strengthening, when not in use may form a settee. Patent 1539214. W. G. Shockey, 6237 Magnolia Ave., Chicago, Ill.

PIPE REAMER.—Adapted for use in connection with cleaning tobacco pipes, collapsible when not in use. Patent 1540697. H. Kruesheld, 75 Summit St., Newark, N. J.

COMB AND CLEANING DEVICE THEREFOR.—The cleaning device being inconspicuously carried and instantly accessible. Patent 1537397. B. L. Wilhelm, 5327 So. Paulina St., Chicago, Ill.

LADDER STOOL.—Which when in operative position is rigidly braced, yet when folded may be disposed in a small space. Patent 1537221. G. H. Bugenhagen, Weinrebe, Bldg., Minot, N. D.

VANITY CASE.—Having receptacles for two standard compacts, with access to both compartments and the mirror simultaneously. Patent 1540605. J. J. Cosin, 200 Fifth Ave., New York, N. Y.

SPOOL.—Of the "jenny" type, with a removable end capable of being firmly locked. Patent 1540663. H. O. Taft, c/o Vermont Spool & Bobbin Co., Burlington, Vt.

DEVICE FOR STRAIGHTENING HAIR.—Which will apply the proper amount of heat and the required degree of pressure. Patent 1539898. A. D. Franklin, 581 Second Ave., Daytona, Fla.

CLOSURE FASTENER.—Which may be quickly operated to firmly secure the cover of a crate or box, and easily released when desired. Patent 1540296. M. W. Tozer, Cortez, Colo.

INSOLE FOR SHOES.—Adapted to permit a free circulation of air between the front portion of a foot and the sole of the shoe. Patent 1540430. W. B. Sims, 315 Mason St., Portland, Ore.

WATER FLOW SYSTEM.—Which reduces to a minimum the liability of water freezing in the pipes. Patent 1541719. H. Lacourcier, Maniwaki, Quebec, Canada.

Where Inventors Live

IS the Connecticut Yankee the most inventive of Americans? He is, according to the records of the Patent Office. Here is the ratio of patents issued to population last year in the several states and territories:

STATES	ONE PATENT TO EVERY
Connecticut	1,082
District of Columbia	1,229
California	1,302
New Jersey	1,356
New York	1,503
Illinois	1,536
Massachusetts	1,660
Rhode Island	1,669
Ohio	1,783
Michigan	2,195
Colorado	2,264
Washington	2,372
Wisconsin	2,373
Pennsylvania	2,536
Wyoming	2,663
New Hampshire	2,822
Minnesota	2,922
Oregon	2,967
Nevada	2,977
Missouri	3,229
Maryland	3,279
Montana	3,347
Indiana	3,391
Delaware	3,484
Iowa	3,664
Arizona	4,023
Utah	4,085
Nebraska	4,168
Kansas	4,536
South Dakota	4,580
Idaho	4,852
Florida	4,966
Vermont	5,339
West Virginia	5,381
Oklahoma	5,482
North Dakota	5,566
Texas	5,925
Alaska	6,099
Maine	6,295
Hawaii	7,109
New Mexico	8,007
Virginia	8,046
Kentucky	8,950
Louisiana	9,129
Tennessee	9,700
Canal Zone	11,429
Georgia	12,428
North Carolina	13,191
Arkansas	13,478
Alabama	13,573
South Carolina	16,671
Mississippi	19,463
Porto Rico	324,952
Philippine Islands	739,331

Lawyers and Patent Attorneys

PATENT attorneys are not necessarily lawyers. The Committee on Patents of the House of Representatives thinks they should be. It recommends for passage a bill to prevent fraud, deception or improper practises in connection with business before the Patent Office, and inserts the following section:

> "Section 4. That after the passage of this act it shall be unlawful for any person who has been duly registered to practice in the Patent Office, thereafter to hold himself out as a patent attorney, unless he has been legally admitted to practice law in a State or Territory of the United States or in the District of Columbia; and any person so violating this act shall, upon conviction, be deemed guilty of a misdemeanor and fined not more than $1,000 or imprisoned not to exceed six months."

The purpose of this bill, the committee points out, is to protect the public and especially inventors, from unscrupulous practises of unauthorized attorneys under the present law. The Commissioner of Patents, with the approval of the Secretary of the Interior, is directed to establish rules and regulations for the admission to practice appearing before the United States Patent Office. There is, however, no law at present prohibiting anyone holding himself out as an attorney authorized to practice before the Patent Office.

"Speed Wagons" for Everybody

THE Reo Motor Car Company is not entitled to register the words "Speed Wagon" as a trademark for light motor trucks, according to the decision rendered by First Assistant Patent Commissioner Kinnan. The ground of the decision is that the words are descriptive of the goods, and, therefore, not registrable.

"It is believed a fair conclusion such notation applied to a light motor truck would be understood to mean a speedy truck, one that would quickly transport goods from one place to another," says the Assistant Commissioner. "The term 'wagon' has been, it must be held, frequently applied to motor vehicles in the loose, careless way the public refers to these vehicles.

"It must be held the appellant's mark appearing on a light motor truck would be understood by the public to describe quality or characteristic of the vehicle."

Red-headed Shovels

"NO one may adopt a trademark which will exclude the rest of the trade from using the usual ordinary manufacturing practice established in the trade."

So rules Acting Patent Commissioner Fenning in the case of the Ames Shovel & Tool Company against the Baldwin Tool Works. The Baldwin Company sought to register the words "Red Head" with the handle and part of the shaft painted red. Evidence showed that other manufacturers have been painting shovel handles in various colors for years to distinguish the tools of one owner from another, to preserve them, and for other purposes.

The purpose of applying paint being primarily utilitarian, it is condemned as a trademark, and, the Acting Commissioner points out, the distinguishing colors are limited in number and it would be easy for a small number of persons to adopt all the colors and so shut the rest of the world out from manufacturing the goods at all.

Patents Issued Simultaneously

WHEN two patents issue on the same day which one has priority?

Neither, says the Circuit Court of Appeals, Sixth Circuit, in the case of Sandy MacGregor *et al.* against the Vaco Grip Company.

A golf practicing device, covered by two consecutively numbered patents (1,439,338 and 1,439,339) was copied by the defendants as closely as they thought they could without infringement. When they were sued their defense was that the lower numbered patent lacked utility, and that the other one lacked invention, being anticipated by the patent bearing the lower number.

The court holds that the infringer was estopped from denying the character of utility. The court refuses to inquire into the chronological order in which patents issue on the same day. In general, prior art is pertinent as showing that a patentee is not the first inventor, but a patentee's own patent tends to show the contrary.

Prizes for Inventions

THAT prize offers will stimulate inventions was evidenced recently when the Institute for Patentees in England offered $50 prizes for the best inventions in several classes. About five hundred inventions were submitted and of these one hundred and fifty-two were adjudged to have real commercial value. These will be offered to manufacturers.

The major prizes were awarded to the inventors of a kettle with a lid that will not fall off; a portable fire; a rotoscope based on the theory of relativity for gaging the speed of machinery; and a machine for bending rods and tubes.

The head of the institute is Sir William Grey-Wilson, a prolific inventor. One of his most ingenious devices is in the chicken house. A few grains of corn are placed in a tin beneath the perches. When the chickens wake and peck at the corn, a spring is released which opens the door of the house.

DISPLAY CASE.—Constructed to permit a large number of small articles to be displayed in a comparatively small space. Patent 1539296. E. A. Bundy and W. B. Galvin, Modesto, Cal.

PROCESS OF TREATING FRUIT.—For transforming the natural hard skin of the fig into a semi-plastic state, without injury to the fruit. Patent 1539309. I. S. Goldman, Merced, Cal.

BED.—For automobile tourists or campers, the device is foldable and convenient to carry, strong and adapted to withstand rough usage. Patent 1541432. R. S. Mattingley, Rockport, Ind.

WALL SHEATHING.—Constructed to securely hold an insulating and protecting medium such as plaster or stucco. Patent 1541481. C. O. Cowan, Box 343, Palo Alto, Cal.

SCALP SYRINGE.—Which will permit a proper and thorough distribution of a tonic to the scalp and hair, without waste. Patent 1540863. R. H. Richardson, 2603 Hanover Ave., Richmond, Va.

INTERCHANGEABLE DIRECTORY STRIP.—Such as are used in office buildings, with means for maintaining the strips securely against displacement. Patent 1542789. G. Mackintosh, 38 Henry St., Oceanside, Nassau County, N. Y.

Hardware and Tools

HACK SAW.—Whereby the tautness of a blade may be varied, or the blade quickly set at a variety of cutting planes. Patent 1535931. A. F. Macrini, 524 E. 85th St., New York, N. Y.

SOLDERING IRON.—Which contains its own solder and allows the same to escape in molten form, and is operable by one hand. Patent 1535933. J. Marinos, Tourist Hotel, Occidental Ave., Seattle, Wash.

HOLDER.—Or tongs adapted for use in manipulating swabs, pads, and dish rags, thus protecting the hands. Patent 1538728. B. A. Miller, c/o Lisle Hopkins, Box 86, R. D. No. 5, Tacoma, Wash.

ASH REMOVER.—Which will be effective in preventing the escape of dust in removing ashes from a stove or furnace. Patent 1538,799. C. Griffin, 16 E. Cross St., Ypsilanti, Mich.

BUCKLE.—Which affords facilities for connecting the ends of a metallic strap so that a smooth inner surface will be provided. Patent 1538941. J. M. Jackson, c/o Rope & Cordage Co., Parkersburg, W. Va.

HOT WATER VALVE.—Wherein a sleeve or locking nut coact with the stem of the valve for locking the key in operative position. Patent 1539816. O. L. Whiteman, Coxsackie, N. Y.

TONGS.—Having an arrangement of sharp and dull teeth whereby the gripping action will not endanger the article engaged. Patent 1540694. J. P. Herrick, 904 Society for Savings Bldg., Cleveland, Ohio.

SHELF-SUPPORTING BRACKET.—For supporting glass shelves, preventing longitudinal, lateral or accidental vertical displacement of the shelf. Patent 1540677. J. H. Balmer, 259 Plane St., Newark, N. J.

VALVE.—Adapted to close by screw action like an ordinary valve, but may be closed instantly without executing a number of turns. Patent 1539305. J. J. Dunne, 430 McDonough St., Brooklyn, N. Y.

TOOL FOR APPLYING WIRE CLAMPS TO HOSE COUPLINGS.—Adapted to be easily manipulated to effect a twisting together of the end portions of the binding wire. Patent 1541136. F. W. Gunn, 318 Columbus Ave., Boston, Mass.

SCRAPING BLADE FOR BEARINGS.—Relating to a tool particularly adapted for scraping and truing up bearings in connection with motors. Patent 1540938. R. W. Gordon, Box 132, Rapid City, S. D.

PERCUSSION TOOL.—Operated by compressed air, for drills or hammers, the major portion of the shocks being absorbed before reaching the handle. Patent 1540868. W. H. Scully, Florence, N. J.

COMBINED CORNER SHIELD AND CASTER.—Especially designed for use on trunks or baggage, protecting the same and providing smooth, easy movement across the floor. Patent 1542231. W. S. Garfield, Dothan, Ala.

HAND PUNCH.—In which the punch is actuated by the blow of a mallet, to perforate sheet metal in cooperation with a die. Patent 1540860. G. W. Pobanz, c/o Davis & Taylor, Attys., Geneseo, Ill.

SOLDERING IRON.—Supplying a stream of solder to the heated point, as may be required by the operator. Patent 1540859. A. Plicque, Box 396, Nashville, Tenn.

DOOR LATCH.—Particularly adapted for use on barn doors, and including a pivoted bar and a gravity keeper. Patent 1541992. B. E. Moriarty, Howard, S. D.

JACK.—Which with a relatively small force will move two separate members in a straight line, and hold them in adjusted position. Patent 1542213. T. P. Brockett, c/o D. C. Humphrey, Atty., Goldsboro, N. C.

MARLINSPIKE.—Which will facilitate the operation of making a splice and drawing the strands in a wire cable or the like. Patent 1542656. E. Balod, 25 South St., New York, N. Y.

SASH LOCK.—Automatically locking a window in partially open position, and preventing a further opening from the exterior. Patent 1542754. M. W. Wragg, c/o W. J. Helmkamp, 485 So. Main St., Akron, Ohio.

SHEARS SHARPENER.—In which adjustable means is provided for producing a uniform cutting edge to shears having cutting edges at various pitches. Patent 1541835. J. E. McKinley, Oakland, Neb.

Heating and Lighting

OIL BURNER.—For use with stoves and ranges, wherein the oil and air are thoroughly heated prior to their admixture and combustion. Patent 1540633. O. C. Kinsolving, 917 Central Ave., Nashville, Tenn.

ACETYLENE-GAS GENERATOR.—Which will maintain a constant uniform output of gas, be safe to operate and remain cool at all times. Patent 1540250. J. H. Brown, 938 W. Granite St., Butte, Mont.

RADIATOR.—Comprising a plurality of sections having upper and lower headers, and means for connecting adjacent sections together. Patent 1540851. DeWitt T. Lyon, 4353 Kenmore Ave., Chicago, Ill.

HEATING CABINET.—For preparing various food products, and in which the heat control is automatically regulated. Patent 1541673. J. A. Valenta and J. Kovar, Taylor, Texas.

HEATING FURNACE.—Designed to prevent the expansion and escape of gases of combustion before consumption, thereby deriving a greater heat value. Patent 1542193. F. A. Wald, Camp Hill, Pa.

ATTACHMENT FOR PLUMBERS' POTS.—Which can be disposed over the pot to deflect the heat downward on the metal within the pot. Patent 1542653. F. Armbrust, Jamestown, R. I.

Machines and Mechanical Devices

NEEDLE-OPERATING MECHANISM.—Especially adapted for use on the so-called flat knitting machines. Patent 1534973. A. Leviton and W. Kaplan, 156 Broadway, Brooklyn, N. Y.

DISPENSING MACHINE.—Designed for use in restaurants, motion picture theatres and like places for dispensing tickets or checks. Patent 1535915. P. Ganz, Box 26, Grand Central Station, New York, N. Y.

SAFETY FEED AND AUTOMATIC STOP FOR WRINGERS.—Wherein the feed mechanism when moved to a predetermined position, will actuate a clutch to throw off the power. Patent 1537864. H. L. Morin, 455 Columbus Ave., Aldenville, Chicopee Falls, Mass.

FEEDING DEVICE FOR PRODUCING SPIRAL STITCHES.—Which may be readily attached to a sewing machine for automatically moving the work holder. Patent 1535966. B. Tucker, c/o The Star Sewing Machine Co., 1 West 4th St., New York, N. Y.

REMOTE-CONTROL TYPEWRITING MECHANISM.—Applicable to line telegraphy systems as well as wireless, by means of which messages may be printed automatically at the receiver. Patent 1535176. I. Nachumsohn, 937 Hyde Park Blvd., Chicago, Ill.

BUTTONHOLE-SEWING MACHINE.—By means of which the stitches of the bar lie closer together than do the stitches which surround the edges. Patent 1536002. A. Hennig, c/o Fehlert & Co., S. W., 61 Belle-Allianceplatz 17, Berlin, Germany.

MACHINE FOR CUTTING PAPER LENGTHWISE AND REWINDING IT.—By the use of rotary cutters capable of being laterally moved according to the widths of cutting. Patent 1539748. G. Laroche, c/o C. Chassevent, 11 Boulevard De Magenta, Paris, France.

ELEVATOR FOR STAIRWAYS.—Which may be installed in an ordinary stairway and serve to convey people or baggage up or down. Patent 1535106. C. C. Crispen, 708 No. 17th St., Harrisburg, Pa.

AUTOMATIC HUMIDIFIER.—Constructed to attract attention, and of a size which permits of its use in a showcase for cigars. Patent 1535287. E. B. Beeler, 2915 So. Wabash Ave., Chicago, Ill.

CONCENTRATOR.—Constructed to automatically effect a separation of the heavier mineral particles from ore or from mill tailings. Patent 1534536. C. M. Meyer, Box 472, Wallace, Idaho.

FOUNTAIN.—Having a spraying outlet, leading from a pump, and means for securing the unit to an opening in a bowl. Patent 1535964. A. J. Tizley, c/o E. F. Caldwell, 38 W. 15th St., New York, N. Y.

DRIER FOR PAPER MACHINES.—Having a siphon for the removal of the water of condensation from the cylinder, during the operation of the drier. Patent 1537792. F. W. Aucutt, c/o Mr. Waldo Rosebush, Inland Empire Paper Co., Milwood, Wash.

TIDE MOTOR.—For converting the natural forces of the rise and fall of water into a form of power for industrial purposes. Patent 1537560. C. F. Stegmeier, c/o Encino Country Club, 333 J. W. Hellman Bldg., Los Angeles, Calif.

TYPEWRITER.—This inventor has been granted three patents of a similar nature, the main object of which is to provide for carrying capital and small letters of a plurality of styles of type. Patents 1537147, 1537148, 1537149. J. Smith, Moran, Mich.

DENSOMETER FOR TESTING FABRICS.—Designed to test the construction of paper, the density of material, or the compactness of fibres. Patent 1538793. F. E. Gallagher and W. M. Peckham, c/o John A. Manning Co., Troy, N. Y.

CARROUSEL SWING.—Including a gyro-suspension for a passenger seat adapted to be readjusted at will, and to swing when desired like a pendulum. Patent 1538828. G. Lammermann, c/o Andrew Staab, 7 Albany St., New Brunswick, N. J.

APPARATUS FOR PREPARING LIVING TREES FOR COLORING THE WOOD.—Comprising means for boring the lower trunk in grid-like manner for the introduction of the dye-stuffs. Patent 1538745. O. Reimann, Charlottenburg, near Berlin, Germany.

SUGAR MILL OR CANE CRUSHER.—In which pressure on the crushing rolls is automatically kept at a given tension. Patent 1539502. R. T. E. Okrassa, c/o F. G. Triebel, 1 Grosvena Rd., Haylake, Cheshire, England.

SQUARING DEVICE FOR CUTS AND FILMS.—Including novel means for accurately centering a cut, and to trim the same for printing. Patent 1539704. H. Texoon, 133 E. 16th St., New York, N. Y.

ROTARY PUMP.—Adapted to pump fluids of different kinds as for instance air and gas at a comparatively high speed and maximum compression. Patent 1539728. W. B. Ensign, 2350 Creston Ave., Bronx, N. Y.

WORK BENCH.—Which is portable and may be easily secured and held in operative position for a plumber, joiner or other mechanic. Patent 1539059. J. B. Sawyers, 2309 Fillmore St., Amarilla, Texas.

GAS-MAIN STOPPER.—Comprising a collapsible frame which may be passed through an opening and expanded to cut off the gas. Patent 1539730. P. Goodman, 523 Atlantic Ave., Brooklyn, N. Y.

ATTACHMENT FOR EMBROIDERY MACHINES. Adapted to be operated by the machine to release the take-up operating means when the fabric is being moved. Patent 1540714. A. Rausse, Box 72, Northvale, N. J.

DRYING MECHANISM FOR PRINTED SHEETS.—Which will automatically move the sheet to a drying position as fast as it is discharged from the press. Patent 1540687. A. V. Feistel and J. W. Rocks, 162 Adelphi St., Brooklyn, N. Y.

EGG-TURNING DEVICE FOR INCUBATORS.—In which the egg trays are mounted in units and adapted to be tilted through an arc of ninety degrees. Patent 1540199. H. H. Treffer, 119½ E. Second St., Davenport, Iowa.

DISHWASHER.—Adapted to be attached to a faucet, and manually revolved, while the water runs through a mop to clean the articles. Patent 1540457. Elsa Boyance and Marie Pekary, 600 W. 150th St., New York, N. Y.

DIE FOR GARMENT CLASPS.—Whereby clasps may be securely fastened to a garment without injury, and in large numbers. Patent 1540690. M. L. and P. L. Friedman, 37½ St. Mark's Place, New York, N. Y.

LOOM FOR WEAVING MATS.—Of a highly resilient nature, formed from a single length of rope, and adapted for use in bowling alleys. Patent 1540595. N. Brauer, 1675 Avenue A, New York, N. Y.

Medical Devices

SERUM EXTRACTOR.—Of such construction that serum may be extracted without the slightest possibility of dirt or other foreign matter entering the dispensing bottle. Patent 1534913. E. C. Buck and C. Christiansen, Box 335, Howard, So. Dak.

DENTAL MIRROR.—Having a double vision, the mirrors being so supported that access to ordinarily inaccessible places in the mouth can be had. Patent 1540409. R. E. McCray, 327 Main St., Fairmont, W. Va.

INCISAL GUIDE.—For use in connection with dental articulators in the arranging of artificial teeth. Patent 1540639. J. A. Lentz, Phoenix, Ariz.

Prime Movers and Their Accessories

VALVE LIFTER.—Particularly designed for use in connection with the valves of the engines of motor vehicles. Patent 1533307. S. S. Davis, 1114 Stratford Ave., South Pasadena, Calif.

SPARK PLUG.—That will give a double spark and therefore better adapted to ignite a charge ever under unfavorable conditions. Patent 1533308. S. S. Davis, 1114 Stratford Ave., South Pasadena, Calif.

PISTON RING.—Providing two rings in combination, one for expansion only, the other adapted to carry off the lubricant. Patent 1535069. E. O. Weatherwax, 1733 Pine St., San Francisco, Calif.

ROTARY VALVE FOR GAS ENGINES.—Having a tortuous path for the combustible mixture, whereby the same will come in contact with the heated walls for thorough vaporization. Patent 1540941. A. J. Krause, 1408 E. 25th St., Cleveland, Ohio.

VAPORIZER.—Designed with reference to the use of a lower grade fuel than is possible with the usual engine. Patent 1540626. L. M. Higgins, Carpinteria, Cal.

PISTON RING.—For internal combustion engines, having particular provision for pressing the ring downwardly and outwardly for preventing leakage of compression. Patent 1541944. H. A. Guerlay, 111 Preston Ave., Houston, Texas.

OIL CUP.—Constructed for use with either gas, steam, or air engines, for automatically feeding a given quantity of oil during the engine's operation. Patent 1542044. L. C. Dutro, 2020 Cerritos, Long Beach, Cal.

Railways and Their Accessories

RAILROAD TIE.—Consisting of a pair of interfitting sections, which eliminate the time and labor required for the spiking operation. Patent 1541688. G. B. Cox, Wray, Colorado.

RAILWAY.—Of the monorail type, having means for maintaining the car in upright position and against rocking movement. Patent 1541281. F. H. Ricker, Los Angeles, Cal.

GRAIN-CAR DOOR.—An auxiliary door, adapted to be detachably secured beneath the main door, to permit the flow of part of the grain. Patent 1542224. J. E. Drake, Blue Rapids, Kan.

Pertaining to Recreation

ROWLING GAME.—Comprising a board with radially arranged spaces, an indicator to be revolved, the score being determined by the space at which the arrow rests. Patent 1540288. E. C. Schallis, Box 31, West Hoboken, N. J.

AMUSEMENT APPARATUS.—Permitting contestants to discharge missiles at various rates of speed and at a plurality of distant targets. Patent 1539648. E. F. and C. P. Chester, c/o Chester, Pollard Co., 1416 Broadway, New York, N. Y.

GOLF-PRACTICE APPARATUS.—Which may be set up at home, for the practice of "pitching" with a niblick, over obstructions. Patent 1540350. D. D. Longenecker, 1060 Bush St., San Francisco, Cal.

TOY BOAT.—Which has spring power, so constructed that it will travel for considerable distance, either in a straight line or in circles. Patent 1539906. A. Kleinohle, 5320 Camp St., New Orleans, La.

SOUNDING TOY.—Wherein means within the doll will create a blast of air sufficient to operate a harmonica or a horn. Patent 1540708. G. H. Parsons, c/o Averill Mfg. Co., Wales Ave. and 143d St., Bronx, N. Y.

TOY WITH VOICE AND MOVABLE FEATURES.—The movement of certain limbs causing movement of others and the production of a sound simulating a voice. Patent 1541479. I. E. Cohn, 65 Fourth Ave., New York, N. Y.

SHAFT FOR POLO MALLETS AND THE LIKE.—Possessing proper resilience or "whip," and improved form of grip, and unusual strength. Patent 1541736. H. C. Overin, 725 Boulevard, E. Weehawken, N. J.

GAME.—Which is played with dice, is highly interesting and requires considerable skill. Patent 1541680. H. V. Bergquist, 106 Bleecker St., New York, N. Y.

Pertaining to Vehicles

CLUTCH RELEASE.—Adapted to stop a tractor when an increase in the load on a trailer passes a predetermined point. Patent 1534699. J. I. Gardner, Lakeside, Arizona.

TRAY AND SUPPORT THEREFOR.—For use in connection with automobiles, the device may be quickly positioned as a table, without scratching the finish of a car. Patent 1534095. T. B. Walker, 416 Chamber of Commerce, Nashville, Tenn.

BRAKE.—With means for coordinating the emergency and service brakes, by the depressing of a common pedal which controls both. Patent 1535092. R. B. Bell, Box 1091, Miami, Fla.

TRAVELING KIT.—Consisting of a table or bed, with tent covering, chairs, and a cook stove, capable of being compactly carried on the running board or rear of a vehicle. Patent 1535357. J. M. Thomas, 1206 Tampa St., Tampa, Fla.

AUTOMOBILE SIGNAL.—In the form of a signal arm manually operated from the inside of the vehicle. Patent 1535265. S. A. Stoetzel, 4917 Davenport St., Omaha, Neb.

AUXILIARY DRIVING ATTACHMENT FOR AUTOMOBILES.—Which may be readily connected to the axle of an automobile and be driven by said axle to operate machines. Patent 1535255. C. E. Ryan, c/o Braden & Co., Tulsa, Okla.

SCRAPER.—For roads, which is mounted on wheels at the rear of the bucket, and provided with dumping power. Patent 1535283. P. C. Anderson, 519 So. 27th St., Lincoln, Neb.

STEERING ATTACHMENT.—Connecting the usual steering gear with a foot pedal, whereby the automobile may be steered to the operation of the pedal. Patent 1540608. G. K. Dawson and H. R. Luce, 836 Seventh St., San Bernardino, Cal.

COMBINATION AUTOMOBILE CUSHION AND PILLOW.—Readily adjusted to assume different forms such as a cushion and back rest, or a pillow of an infant. Patent 1540,685. E. A. Eiband, New Braunfels, Texas.

ANTISKIDDING DEVICE.—Under the control of the operator for instant release, but normally out of operative position. Patent 1540624. E. H. Haupt, 9 Maiden Lane, New York, N. Y.

SPRING WHEEL.—In which the spring elements are radially disposed and connected between the hub and the rim. Patent 1541,739. K. Piesch, 1736 Fourth St., New Orleans, La.

ASSEMBLING DEVICE.—Designed for holding the bands in position on the transmission drums of a Ford car during the application of the cover. Patent 1540760. O. C. Cardin, c/o J. S. Klingman, Chadron, Neb.

AUTOMOBILE LUBRICATING MECHANISM.—By means of which, from one convenient source, all the remote points of the machine may be lubricated. Patent 1540683. L. E. Durrin, Juan Bautista, Cal.

WHEEL.—Including a demountable rim, which may be quickly removed or replaced without the use of special tools or unusual skill. Patent 1541284. F. W. Schroeder and J. W. Wilcox, R. F. D. No. 1, Bemidji, Minn.

SLED ATTACHMENT FOR AUTOMOBILES.—For use in propelling the rear wheels over snow or ice and a runner element to be disposed in front. Patent 1542625. H. L. MacGown and H. G. Clark, c/o Harry G. Clark, Gorham, N. H.

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

The Airplane Supercharger Is Now Being Used on Racing Motor Cars

SUPERCHARGERS, which have been used for some time on the motors of airplanes for high altitude flights, are now also being used on racing motor cars for increasing the efficiency of their engines. The supercharger is simply a centrifugal air pump, driven by a small gas turbine operated from the exhaust of the motor and its function is to increase the normal pressure of the air so that the engine gets more air. The ordinary air compressor is by far too heavy for use on an airplane, but the small supercharger, operating on a different compressing principle from that of the ordinary air compressor, is light in weight and takes up little space.

The supercharger, which was developed by the General Electric Company (in the United States) derives its energy from the exhaust of the gasoline engine. Thus it is really a small gas turbine. This gas turbine revolves at an extremely high rate of speed and in turn it drives the rotor of a centrifugal air pump which is connected to the end of the gas turbine shaft.

If the atmospheric pressure at the height at which the airplane is flying is four or five pounds per square inch lower than that at the earth's surface, the supercharger will bring the pressure up to normal.

The rotor or air pumping part of the supercharger operates on the same principle as the rotor or "runner" of a centrifugal water pump; that is, it actually *throws* the air. Air, like water, is a fluid and it may be pumped in the same manner, centrifugally; but since it is a much less dense fluid than water the rotor of the pump must revolve very much more rapidly in order successfully to pump it.

"Why," one asks, "if the purpose of the supercharger is to raise the pressure of the upper atmosphere to that at the earth's surface, is it necessary to employ the supercharger on a racing motor car?" The answer is, it is not necessary; but with an engine which makes such a high number of revolutions per minute and which therefore must suck in its supply of air for carburetion at extreme velocities a condition arises which is analogous to that of the airplane motor at high elevation. That is, the air friction is so great that not enough air can get into the carburetor. Therefore its pressure is low at that point. The supercharger brings this pressure up to an amount much greater than the atmospheric pressure and thus adds to the power of the motor of the car.

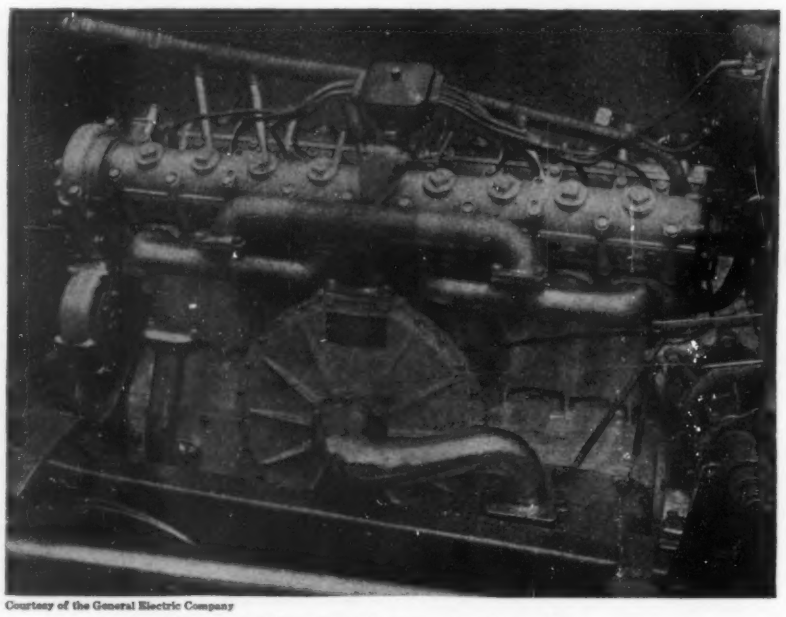
Tests on the race track and on the test block have shown that the new supercharger actually produces a pressure of ten pounds above atmosphere in the intake manifold, as against about one pound below atmosphere which occurs in an intake manifold without supercharging, making a total pressure rise of about eleven pounds per square inch.

Supercharging at sea level differs from supercharging at high altitude in that the former gives a pressure in the intake manifold greater than that normally required, and therefore an appreciable increase in power. Supercharging at high altitudes, however, gives a pressure in the manifold just equal to that which would occur at sea level.

Supercharging has three advantages for racing cars. The first is that a much greater weight of charge is forced into a cylinder of given displacement than would otherwise be handled. The second is that the increased pressure in the cylinder at the beginning of the suction stroke and end of the exhaust stroke scavenges the burnt gas out of the clearance space during the short period when both inlet and exhaust valves are open. The third is that the passage of the gasoline at high speed through the vanes of the supercharger thoroughly atomizes it and makes a much better mixture than can otherwise be had.

In all automobiles there is great difficulty in getting the cylinder supplied with a uniform mixture. In order to insure this on racing cars it has been customary to use eight carburetors, one for each cylinder. With the supercharger, only one carburetor is necessary.

A "tame tornado" is one way in which the new supercharger has been referred to. Operating on the centrifugal principle, air is forced into the manifold under pressure by a rotating element. The wheel, which is 7½ inches in diameter, revolves 30,000 times a minute. Such a speed, therefore, gives the rim a velocity of 11 1/6 miles a minute. Thus it whirls at the rate of a mile in but slightly more than five seconds.



Courtesy of the General Electric Company

The supercharger adds power to the motor car

The Acid Fruit Bogey

PEOPLE who fear certain fruits, such as strawberries and oranges, because they are "so acid" will be surprised to hear that these and other fruits, when taken into the body, are easily oxidized into alkalis.

This knowledge has been gained only within recent years. A discussion of the question of acid fruits appears as an editorial in the May 30, 1925, issue of the *Journal of the American Medical Association* (Chicago). When tested in the chemical laboratory these fruits prove to be acid; but what goes on in the test tube does not necessarily go on in the same manner in those far more intricate test tubes, the human digestive organs.

The substances responsible for most of the evident acidity of certain fruits and vegetables are acid salts of organic acids, says this authoritative medical journal. Citric, malic and tartaric acids belong in this category, although it is true the tartartic acids can function as acids in the metabolism of the body.

The fate of other organic acids may be quite different. Thus, when the acid potassium citrate of oranges is absorbed into the system, its citric acid is oxidized, leaving potassium carbonate in its place. This potassium carbonate actually acts to increase the reserve alkalinity of the body fluids!

Scientists have recently found that drinking even large amounts of orange juice always results in the production of alkaline urine. It was impossible, they found, to overreach the body's ability to oxidize the citric acid of the oranges into alkali, even though the amount drunk was the equivalent of twenty-four large oranges eaten daily. Consequently it has become customary to speak of some (not all) of the acid fruits as potentially alkaline. The principal acid contained in strawberries, pineapples, raspberries, grapes is citric acid, and this acid is easily changed to alkali. We may therefore safely dismiss much of the prejudice that their acid reaction in the laboratory has unjustly directed to them.

* * *

What of the Electric Refrigerator?

YOU have seen the electric refrigerator advertised for a number of years, yet you do not yet find them in universal use, nor are they yet even commonplace. Although the initial cost of these home units is no higher than that of the flivver, and the upkeep less, they have not yet reached the stage in their evolution where operation is near enough to perfection to bring the wide market which their many good points warrant were they as dependable as, for example, the electric light.

At present there are about seventy-five thousand of these devices in use in American homes. The number is steadily increasing, largely because the dependability of these refrigerating units is gradually approaching the desired goal.

The National Electric Light Association has issued a report of its Electric Refrigeration Committee, which should be purchased by everyone who is considering the advisability of acquiring a home refrigeration unit. This report has the exceptional merit that it discusses the various manufactures of units by their names.

During the past year, says the report, quantity production has enabled at least two manufacturers to reduce the selling cost of these units to about $250. Service records indicate a very material improvement in performance of the electrical equipment as compared with the record of two or three years ago. "However," continues the report of the committee, "the refrigerator machine manufacturers still complain to the effect that the motors offered to them are not entirely satisfactory for this particular service."

The committee suggests that the refrigerator machine manufacturers appoint a committee of their engineers with instructions to draft a general specification covering motor requirements for this service, submit that to the electrical motor manufacturers and see whether it is possible to build motors that will better serve these exacting requirements.

The report states that, "the committee's attention has been called to advertising matter sent out by new and comparatively unknown manufacturers in which almost impossible claims of merit were made for untried machines."

There are many excellent selling arguments for the electric refrigerator for home use, but its worth is so self-evident, that it is hardly necessary to quote them. The principal obstacles to their universal adoption is the fear that they will get out of order at some critical time beside the initial cost of purchase. Steps are continually being taken to make them so dependable that they will not fail, at least not more frequently than the present ice man fails. This, by the way, is a point many people miss, in comparing the electric refrigerator with the iced refrigerator.

The report also states the number of units that have been made by the various manufacturing companies. It is surprising to discover that 35,000 units have been sold by one manufacturer, 27,000 by a second, while the remainder of the manufacturers do not seem to have sold nearly as many, the nearest competitor having sold only 3,500, the next, 1,100; and the others, 154, 36, 25 and 35, respectively. This, of course, need not in itself necessarily stand against the small manufacturer.

The chairman of the committee presents an interesting summary of the comparative cost of refrigeration brought to the house through the electric wire and refrigeration brought in by the ice man. With interest charges figured at six percent, depreciation seven or eight years for the iced refrigerator and twenty years for the electric unit (not subject to moisture and constant charging with heavy blocks of ice); with ice at the average rate of sixty cents per hundred pounds, and electricity at 5.3 cents per kilowatt-hour, with maintenance on the mechanical unit at fifteen dollars per year and on the iced cabinet negligible, the costs of refrigeration per year under ordinary kitchen conditions are: for the iced machine—first cost, $170; interest, $10.20; depreciation, $25.50; service, nothing; ice, $86.40. The annual cost thus figures out at $122.10. The costs for the electric machine are: First cost, $465; interest, $27.90; depreciation, $38; service, $15; electricity, $50.66. The annual cost thus figures out at $131.56, a little higher than the cost of refrigeration by ice.

Although these figures, in themselves, favor the iced refrigerator, the factors of cleanliness, comparative freedom from attention, dry refrigeration, better and more uniform refrigeration, freedom from annoyances connected with the daily visit of the ice man (and the greater annoyance of his failure to visit), and many other points whose value cannot be even roughly estimated, point strongly to the day when the electric refrigerator will be in use in the average home.

Refrigeration, or getting rid of heat (for that is what refrigeration is), by means of solid water (ice), which absorbs it and which must be brought into the house daily in chunks, is a primitive method and a very inefficient, crude one.

(Digest continued on page 196)

It's a *genuine* UV-201-A only when it bears the name Radiotron *and* the RCA mark

WD-11, WD-12, UV-199, UV-200, and UV-201-A are the type names of Radiotrons. They belong to Radiotrons only. To be sure you are buying the genuine, look for the name Radiotron and the RCA mark on the base. Then you are sure of quality.

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AN RCA PRODUCT

A New Metallizing Process

In the laboratory of Dr. M. U. Schoop, Zürich, Switzerland, a new metallizing process has recently been perfected which, from both a technical and an economic point of view, greatly surpasses the present "wire-spraying" method.

In the place of the wire, which in the spray-pistol is automatically moved forward by means of a small compressed-air turbine, finely divided metal powder is now used, thus reducing the apparatus to the simplest form.

There is a central bore with two passages arranged around it in a concentric manner. The device can be fitted to any burner used for welding and cutting. The gases burned, a mixture of oxygen and acetylene, pass through the central bore. The metal powder is driven along the inner of the two outer passages by means of compressed air.

The passages are so arranged that the zone conveying the metal is exposed simultaneously to the cross attack of the central zone of burning gas and of the air pressure from the outer passage so that an even thick flow of extremely fine pulverized liquid metal is produced.

An entirely new feature is that the invention no longer aims at imparting an intensive movement to the metal particles and at "firing" them on to the surface to be covered, so that the energy of movement on coming into contact with the surface changes into heat and welds the small particles together. Instead, flame and the speed of movement of the operation are so regulated that the metal particles are brought on to the surface in a liquid condition and they literally melt themselves on to it.

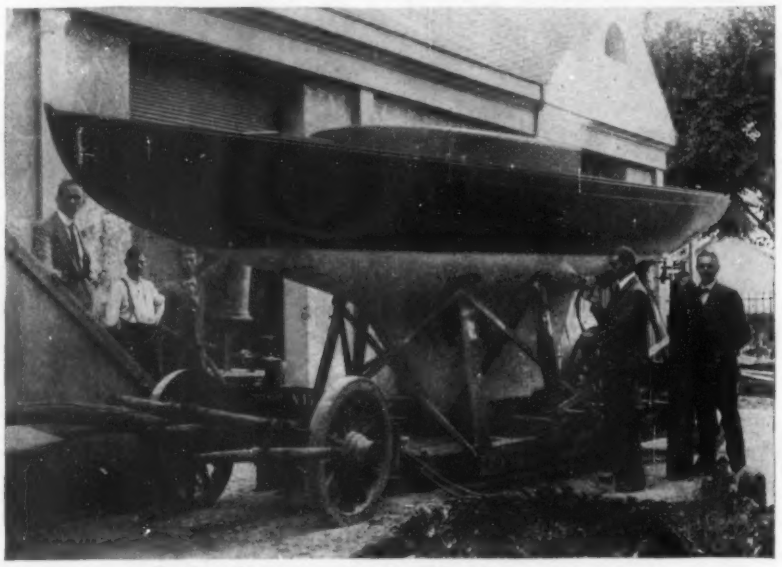
The results of the new procedure in comparison with the former wire-spraying method are astonishing. The coatings are so fine that they cannot be distinguished from galvanized coatings, and finishing-off work such as grinding and polishing can be dispensed with.

The coatings themselves are extremely thick, evenly distributed, and of metallic continuity. As the "metal-beam" remains hot, the well-known experiment whereby the naked hand is metallized in the relatively cold flame, cannot be repeated, but the coating adheres to the surface to be metallized so completely that there is no need for any preparatory work with the sandblast.

As the metal powder obtainable in trade is mostly oxydized, especially the less noble metals—a reducing flame is used and the deoxydization is so successful, thanks to the intensive heating and pulverizing, that out of the darkest copper dust a coating of the typical salmon pink color of pure copper is obtained.

Certain impurities such as traces of glycerine, fat, coal dust, and so on, cause no trouble, says Dr. Schoop. In fact they improve the effect.

If we take all these technical and economic advantages together and further consider the fact that in place of a smart but sensitive and expensive instrument like the wire pistol, we have the small apparatus as described above, then we may safely assume that the new invention will be taken up by all industries concerned even by the smallest firms where the acetylene burner, which the new apparatus to some extent only supplements, is already in use.



Casting the underwater skin of a sloop with metal

Balking the Elements with Nature's Own Defenses

By laying long, green, willow poles in shallow trenches where they quickly send out sprouts at close intervals along their entire length, Mr. O. S. Scheifele, of Conestogo, Waterloo County, Ontario, Canada, has devised a new and excellent way of protecting the shorelines of rivers, lakes and reservoirs against wave and current cutting.

By this inexpensive method practically any earth bank which, owing to the difficulty of quickly establishing enough ordinary vegetation to hold the soil in place and which therefore might be quickly cut away by rain water, may be kept intact. The willow poles are placed on the bank like rafters on a roof and are spaced about five feet apart. Within two months every pole should sprout at intervals of about two feet along its entire length and these sprouts should cover the whole bank with a dense mat of vegetation within that length of time.

The tree used for this purpose is the white willow, says Mr. Scheifele, who has patented the system, and its roots penetrate the soil very rapidly, binding it closely together. If the willow pole planting method is to be used on a large scale, requiring a continued supply of poles, the same tree stumps will be found to supply a new crop of poles. The poles cut, range from two to six inches in diameter and from twenty to twenty-five feet in length, the size, within reasonable limits, being quite immaterial.

Willow poles laid in blow sand areas have helped to prevent further trouble. They are simply laid on the ground and covered with a thin layer of earth. There is then little difficulty in getting willow poles to sprout, provided that there is moisture in the soil in which they are placed. In fact, they are difficult to discourage from sprouting. This was amply demonstrated by a member of the staff of the Scientific American, who made use of willow for beanpoles in his garden. The beans came up first, but the willow sprouts had more vigor and it was necessary, not only to weed the garden, but frequently to remove the persistent regrowth of sprouts.

When the Scheifele system is used to protect the lakeshore banks of property, some adequate temporary provision must be made to prevent the erosion of the banks by the waves and to protect the willow poles until they sprout. One way to effect this is to lay the poles in the earth along the bank, and to build a temporary board fence along their lower ends after the work is done, this fence being inclined parallel to the embankment. In this manner a railroad company which had been put to years of effort and expense fighting the encroachment of waves along its riverside right of way was able to put a stop to the whole fight, simply by placing 80,000 lineal feet of willow poles in the manner indicated above.

Courtesy of O. S. Schiefele

It is hard to keep a willow limb down, even if one wants to

Small willow cuttings have long been used for similar purposes, each cutting being inserted in the earth separately. Such a cutting is shown in the accompanying illustration. However, the root system is not nearly so sturdy as that of the other poles shown in the same illustration.—*The Canadian Engineer* (Toronto, Ontario), vol. 48, pages 171-173 (Jan. 27, 1925).

* * *

Shall We Let the Foundlings Die?

By making a special effort to keep newborn illegitimate babies with their mothers and breast-fed instead of bottle-fed, the Division of Child Hygiene of the Newark, New Jersey, Department of Health, under the direction of Dr. Julius Levy, has reduced the infant mortality from the general large-city, infant-asylum death rate of thirty-six to seventy-five percent of admissions to six or eight percent.

In a paper read before the English-Speaking Conference on Infant Welfare at Caxton Hall, Westminster, London, England, Dr. Levy explained at length how this remarkable work was made successful. He divided the admissions of institutions for foundlings into five classes; the born in, the committed, the surrendered, the accepted and the true foundlings.

The *born-in* class is actually born in the institution but is soon left there by the mother. Committed infants are those who have been sent to some institution by some public authority. The surrendered infant is accepted by an institution with the understanding that the mother gives up all right to it, either to know its whereabouts or its well-being. The accepted foundling is taken with its mother and both remain at the institution. The fifth class includes the true foundlings, found, that is, deserted and without clue to antecedents.

Society, says Dr. Levy, owes these people —for potential people they are—a new deal. For most of them, society is responsible. When we study the history of foundlings we quickly discover that the result of their present treatment does not vary much from that of China in the Eleventh Century, or of Italy of the Eighth Century, or of France or England of the Seventeenth Century. We have advanced in many other ways, but apparently the smug prudishness which has only recently begun to wane has prevented the proper attack on this problem, a large part of which attack consists of open, frank, public admission that there is such a problem to face.

In Naples, in the Eleventh Century, a foundling hospital with 3,000 infants dug a single long trench each day of the year and only ten of each hundred escaped one of these 365 graves.

During twenty years only 2,100 infants out of 19,420 received by the Hospital of Dublin remained alive. Closer to our own day, yet before we knew much about the science of life and medicine, the Montreal Board of Health reported but 292 out of 4,059 infants received between 1865 and 1870 as being alive at the end of that period.

These conditions were those of the Dark Ages—what of those of our own age? Better, but not decidedly so. The infant mortality from the eleven largest foundling institutions in New York between 1909 and 1913 was forty-two percent. This is five times the average infant death rate of the State of New York. In one institution Dr. Levy found that from 1900 to 1910, sixty-eight percent of the infants never reached their first anniversary.

In one New York institution where foundlings are classified according to the five classes named above, the key to the solution of the problem (as far as it can be practically solved at present) was found while studying the widely varying death rate of the five respective classifications. The *born-in* class had a lower rate than the city as a whole, for the mothers stayed in the hospital with the infants of this class and nursed them for one month. When, however, at the end of a month the mothers left, what happened? Nearly fifty percent died before the year was over. The infants had been weaned too soon.

But the *accepted* class, where mother and infant were taken together and kept, had a fatality of only twenty-seven percent. These figures point directly to one solution of the problem, and that is the solution which the city of Newark has been taking. The city Department of Health, whose function is to maintain the life of every infant, makes whatever special effort is necessary to keep the new-born baby with its mother, and breast-fed. The hospitals notify the Department of Health of the admission of every unmarried mother. A representative of the department then visits the hospital and gathers from the girl her history and tries to convince her that she can and should nurse her baby. Visits are made to the family to arrange for the return of the girl with her baby.

"We have been unusually successful," says Dr. Levy, "in accomplishing this in a very large percentage of cases." An institution known as the Convalescent Home for Nursing Mothers has been established. Here mothers whose own families will not receive them can go—in fact any others may go there, the only condition being that they are nursing their babies. There they remain three months.

If the baby can be breast-fed for three months its chances of survival are vastly enhanced. This is the crux of the best solution of the foundling problem so far discovered.—*The American City Magazine* (New York), vol. 32, pages 179-182 (Feb., 1925).

Courtesy of O. S. Schiefele

Bound together with these year-old sprouts this bank will not wash away

They Gave It Legs

When a Timken-equipped tractor grew legs and became a lumber carrier, Timken Bearings went into the new wheel mountings also.

The Timken-equipped Bulldog Lumber Carrier manufactured by the John Wood Iron Works of Portland joins all the Timken-equipped pulley blocks, carts, trucks, tractors, bummers, resaws, line shafts and other Timken-equipped machinery in the lumbering industry.

The presence of Timkens has come to be the sign of good equipment in lumbering, as in all industry.

THE TIMKEN ROLLER BEARING CO., *CANTON, OHIO*

Technical information regarding bearing sizes and their mountings, can be secured from the Timken Roller Bearing Service and Sales Company's Branches located in the following cities: Atlanta, Baltimore, Boston, Buffalo, Chicago, Cleveland, Dallas, Denver, Detroit, Indianapolis, Kansas City, Los Angeles, Memphis, Milwaukee, Minneapolis, Newark, New York, Omaha, Philadelphia, Pittsburgh, Portland, Richmond, St. Louis, Salt Lake City, San Francisco, Seattle, Toronto, Winnipeg

TIMKEN

Tapered

ROLLER BEARINGS

GMC

ALWAYS, the efficiency of motor truck transportation must be measured in ton miles per dollar. So measured, the constant advancements and improvements in the structure of General Motors Trucks show clearly their immense value to the haulage buyers of America. From the beginning of the truck industry, General Motors Truck Company has required GMC Trucks to show a consistent increase in the value of the service they perform, and a steady decrease in the cost of performing it.

General Motors Truck Company, Pontiac, Mich.
Division of General Motors Corporation

General Motors Trucks

Undaunted

Mr. Blank (name omitted by request) sent us a couple of photographs and a letter describing the apparatus which he and a friend used at the time of the eclipse. Here's hoping he will have better weather in 1932.

* * * "I am sorry that I have no more to report or to contribute on the eclipse, but a very local weather condition at Bridgewater, Connecticut, in the shape of a cirro-cumulus cloud frustrated the attempts which a friend and I had prepared to make to take photographs. Our apparatus was, I think, interesting and somewhat amusing. We built a spruce scantling frame on which we mounted an eight foot, six by six inch spruce timber for the polar axis; on this a match-board cradle served as the declination axis and on this cradle we mounted three compo-board cameras, one of twelve feet, three inches, the others—in a two-compartment box—of forty-eight-inch focus using a double meniscus monocle for the object glass in the former and the two lenses of an old portrait camera in the latter. Our r.a. slow-motion clock utilized the overbalanced weight of the camera (which we mounted to overhang on the west side) and a long-stroke tire pump in which we substituted a needle valve for the air hose and which, when filled with kerosene with its barrel stirrup wired to the upright of a horse sled and its pump handle slung to the outer end of the long camera, demonstrated complete efficiency within the small angle of motion required for operation. But about four minutes before totality that cloud interfered with our program. My Clark four-inch telescope was, however, adequate to take what I believe were close time observations for beginning and end of totality.

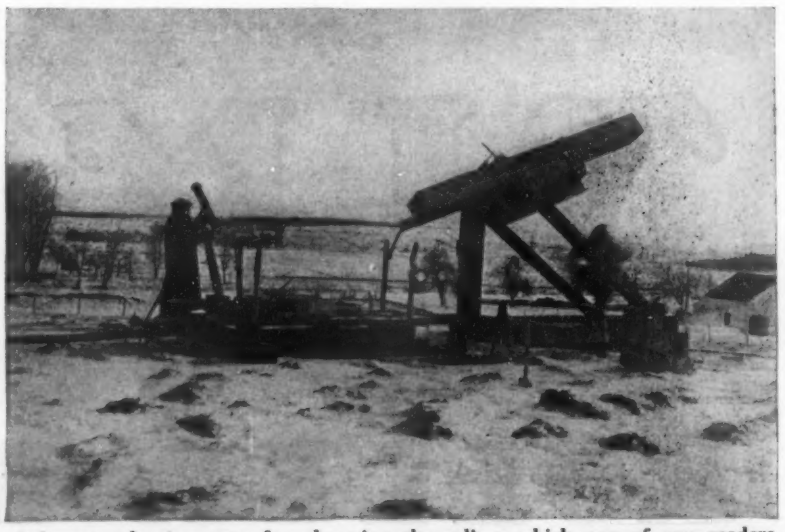
"Having had our experience and presumably improved our technique, we are quite determined to repeat our attempts on August 31, 1932, at 3:00 P.M., somewhere in the State of Maine. I think I have the date, hour and locality correct, although I am drawing on my memory for the calculated data of the next total eclipse visible in this neighborhood. . ."

Shares Our Point of View

Mr. Washburn tells us that he began reading the Scientific American in India in 1860, and that he is still a subscriber. He is now approaching his 93rd birthday, and we wish him every happiness. Three cheers for such a record!

"I fancy I am among the oldest in point of age and also as a reader of your journal. I am nearing my 93rd birthday. I began to read your paper in a Newspaper & Review Club in The Madura Mission, S. India, in 1860, and continued to read it regularly in that club till I retired from service in 1900. On arriving home I at once subscribed for your paper and have been an uninterrupted subscriber and reader of it for the last twenty-five years; though for the last two or three years I have had to depend on my reader to read it to me; and he will continue to do this probably as long as I live.

"I always read your page, 'Our Point of View.' It is often mine. Your articles, The Chemist's Service; Mr. Russell's astronomical articles; those on the radio and radio notes; your psychic articles; your digest and many of your miscellaneous articles, long and short. I do not agree with a late critic of the makeup of your paper. You seem only to be keeping up with the times, or leading in psychic matters. I hope you will continue till you can demonstrate beyond doubt that the alleged phenomena are manifestations of psychic energy or plain jugglers' tricks, and till you have identified the new force and measured its wavelength, if force it be. You are doing something constructive. I hope too you will keep up your chase of the atom. It is amazing what human beings can do."



A home-made apparatus for observing the eclipse which one of our readers describes above

Fulsome Praise

For fifty years a subscriber—that's the way we like to please our readers! We hope the writer of this letter will continue to find much to interest him in future issues. Wonder if the nephew—who liked to ride on fire horses—is also numbered among our family of readers?

Meriden, Conn.

Dear Editor:

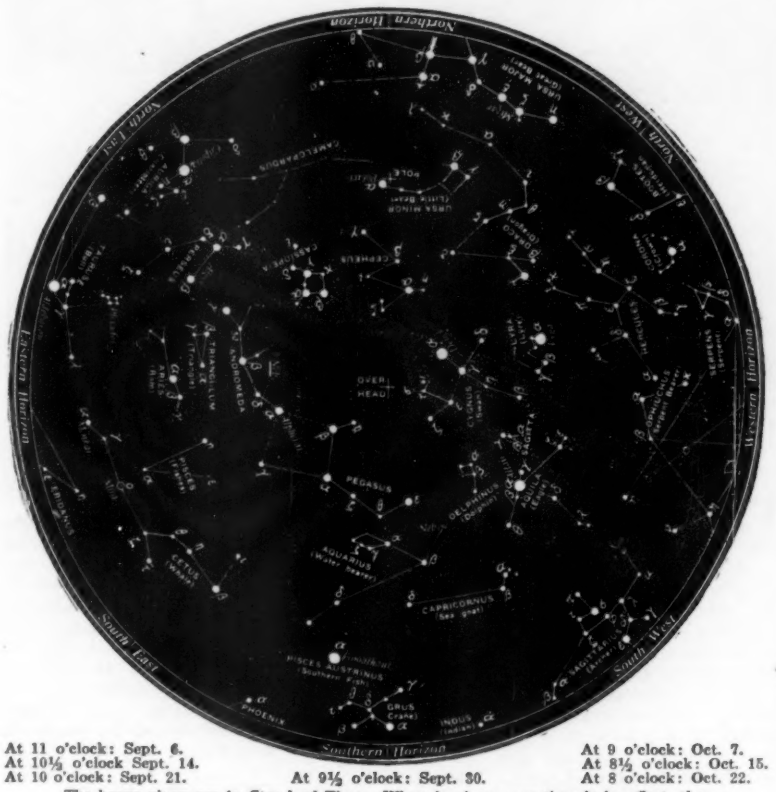
In the April number of your valuable magazine, page 230, is a picture of the last run of the fire horses connected with station number 18 Harvard Street, Dorchester, Massachusetts. This to me is a very interesting picture as I used to live not far from this fire house and my nephew has an enlarged picture of this. He has often been placed on the horses and rode about the station when a small boy. . .

I am very much interested in the subject of radio and have had a good set for three years. . . I am pleased to note that you devote so much space to the matter and trust you will continue along this line.

I have been a subscriber to the Scientific American for over fifty years and never expect to find a magazine to take its place. . . Albion C. Bumpus.

The Heavens in September

By Professor Henry Norris Russell, Ph.D.



At 11 o'clock: Sept. 6.
At 10½ o'clock Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Heavens

THE autumn constellations are now well in sight. Following the great arch of the Milky Way overhead, and beginning low in the northeast with Auriga, we find Perseus, Cassiopeia, Cepheus, Cygnus (almost in the zenith) then Lyra, Aquila, and last, Sagittarius, already setting, and carrying the planet Jupiter with it. The Great Dipper is low in the north, with Draco and Ursa Minor above. Hercules and Corona are in the west, and part of Ophiuchus still in sight in the southwest. In the southeastern heavens the most conspicuous group is Pegasus, high towards the zenith, Andromeda and Aries below in the east with Taurus rising. Cetus occupies the southeast and Aquarius, Capricornus and Pisces Austrinus the south.

The Planets

Mercury is a morning star this month, and is well visible about the time of the greatest elongation, on the 11th. Although near perihelion and so only 18 degrees from the sun, he is also seven degrees north of him, and consequently rises more than an hour and a half earlier. He appears brighter than any star but Sirius and Canopus and should be conspicuous, almost due east, in the dawn.

Venus is an evening star, setting at 7:30 P.M. in the middle of the month and very conspicuous. Mars is in conjunction with the sun on the 13th and is invisible. Jupiter is in Sagittarius and remains in sight until the middle of the night.

Saturn is an evening star in Libra setting at 9 P.M. on the 1st and 7:20 on the 30th.

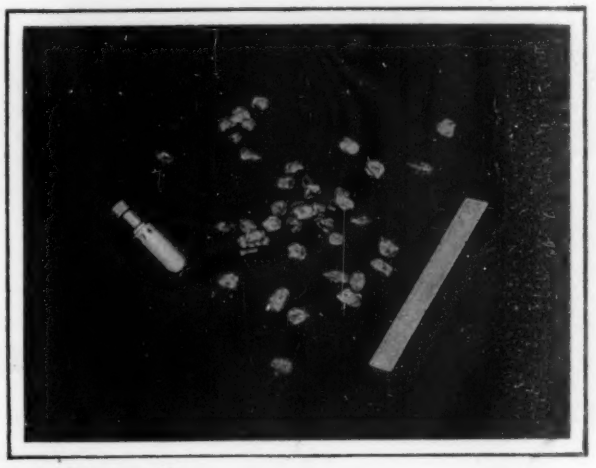
Uranus is in opposition on the 16th and observable all night long. At this time he is in $23^h\ 37^m\ 30^s$ R.A. and 3 degrees 18 minutes 24 seconds south declination and is moving $8^s.8$ east and 56 seconds south per day. He has just entered the constellation of Pisces, and is in a region devoid of good marks to point him out, and full of small stars, so that a good star-map will be needed to pick him up.

Neptune is in Leo and rises about 3:30 A.M. in the middle of the month.

The moon is full at 3 P.M. on the second, in her last quarter at 7 P.M. on the ninth, new at 11 P.M. on the 17th, and in her first quarter at 7 A.M. on the 25th. She is nearest the earth on the 1st, farthest away on the 13th, and at her nearest point again on the 29th. During her month she is in conjunction with Uranus on the third, Neptune on the 15th, Mercury on the 16th, Mars on the 17th, Venus on the 21st, Saturn later on the same day and Jupiter on the 26th and Uranus a second time on the 30th.

On the 27th Venus and Saturn are in conjunction, although more than 3 degrees apart and at 9 A.M. on the 23rd the sun crosses the celestial equator and "Autumn Commences."

FACTS ABOUT A FAMOUS FAMILY



A handful of uncut diamonds and two of the tools in which, after having been cut, the diamonds are set. *At left:* a workman grinding crankshafts with a wheel shaped for this exacting work by diamonds.

Diamonds and dollars

Perhaps it has never occurred to you that diamonds enter into the manufacture of a motor car. They do. There are some cutting tasks which must be done so accurately that only a diamond can do them.

General Motors uses many thousand dollars' worth a year and recently its engineers have discovered a new way of setting them into the cutting tools, increasing their efficiency and reducing the annual diamond bill by half.

Even in so small an item it is important to make a saving—for many little savings, added together, make for the added value in General Motors cars and trucks.

GENERAL MOTORS

BUICK · CADILLAC · CHEVROLET · OAKLAND
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General Motors cars, trucks and Delco-Light products may be purchased on the *GMAC* Payment Plan. Insurance service is furnished by General Exchange Corporation.

There is a Simonds Service Shop or Supply Dealer near you to furnish promptly Simonds quality Circular Saws, Band Saws, Files, and Planer Knives. Write for Mill Saw Catalog.

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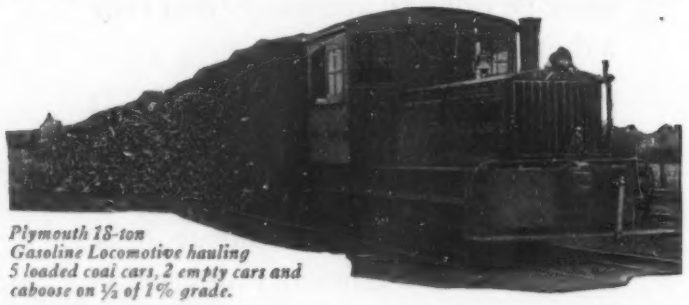
SAWS FILES KNIVES STEEL

SIMONDS SAW AND STEEL COMPANY, Fitchburg, Massachusetts

"The Saw Makers" Branch Stores and Service Shops in Principal Cities Established 1832

Plymouth Cuts Haulage Cost



Plymouth 18-ton Gasoline Locomotive hauling 5 loaded coal cars, 2 empty cars and caboose on ½ of 1% grade.

THIS is a gasoline motor age. In no field of engineering have there been such rapid strides as in the development of the gasoline motor. Always ready, no coal to haul, no "firing up," no boiler troubles, no "stand by" expense—the gasoline motor is rapidly displacing antiquated haulage methods.

The Plymouth Gasoline Locomotive is the pioneer in industrial gasoline locomotive development. It is the pacemaker with more speed, more power and more years of service.

At the industrial plant, in construction work, in the quarry, in the sand, gravel or clay pit, in the mine or forest, or for short-line railroads, the Plymouth is the economical method of haulage. Made in 3 to 20 ton sizes, and in any track gauge, to meet every condition.

Write for Performance Bulletins showing Plymouths in use in every line of industry.

THE FATE-ROOT-HEATH CO., PLYMOUTH, OHIO

PLYMOUTH

Gasoline Locomotives

Learning to Use Our Wings

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics

Courtesy of Spalding Construction Co.

Interior of hangar built for the housing of mail planes. Note the heavy wooden roof truss and the steel columns at the sides

Housing the Mail Planes

THERE are quite a number of problems involved in housing the mail planes. The hangars used at the Hadley Field Terminal in New Jersey, or at Bellefonte, Pennsylvania, must be 100 feet long, 65 feet wide and have a clear height of 14 feet. They must have no columns or other obstructions in this vast space, and yet the huge walls must withstand the pressure of strong winds.

Our first photograph shows the heavy wooden roof truss employed and the steel columns at the sides of the hangar, sunk into concrete foundations and stiffened laterally with heavy steel lintels. This type of construction has proved adequate and the Air Mail is not likely to lose any further equipment through collapse of hangar walls. Again planes may have a wing spread of 40 feet and more. Hence the whole end of the hangar must open up. Swing doors and bascule doors did not prove entirely practical because opening them against a strong wind meant the exertion of real power. Now, the steel doors which take up the entire end of a hangar are in three sections, and roll up exactly like a blind, by aid of a mechanism near the entrance of the hangar.

It may be surprising to read that the new hangars are built partly of wood, since a sacrifice of fireproofing qualities is made thereby. This is because the airplanes themselves are so inflammable that the contents of even a completely fireproofed building would be instantaneously destroyed by fire. The best that can be done to lessen the danger is to slant the floor downwards towards the door, so that the planes which are kept on dollies at all times can be wheeled out by a single man. Heating, too, is quite a job. Nearly 100,000 cubic feet of space must be heated up to work in comfort, with the entire side of the house left open to the wintry blast.

Winter Garb

IT is not uncommon for Army aviators to encounter temperatures of 60 and 70 degrees, Fahrenheit, below zero in flights at six or seven miles altitude. Electrically heated clothing sometimes leads to unpleasant short circuits and according to *Slipstream* the latest Army Air Service specifications call for winter suits without electrical appliances. Fur and leather still offer the best protection against bitter cold and wind.

Our photographs show the latest two-piece outfit, opened and closed. Both blouse and trousers have an outer shell of whip cord, an inner lining of beaverized sheep wool, and

Courtesy of Spalding Construction Co.

Type of hangars for mail planes at the Hadley Field Terminal and at Bellefonte, Pennsylvania. The steel doors roll up like a blind

KEYSTONE
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Black and Galvanized
SHEETS

Formed Roofing Products
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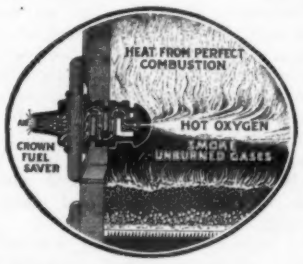
Secure maximum *rust-resistance* from all sheet metal products by insisting upon copper-steel. Its excellence is a well established metallurgical fact. The proof is conclusive.

KEYSTONE COPPER STEEL is an alloy made by the addition of a certain percentage of Copper to well made Steel, thereby increasing its lasting and rust-resisting qualities under actual service condition. Unexcelled for culverts, tanks, flumes, roofing, siding, gutters, spouting, and all exposed sheet metal work. Send for booklet giving results of positive time and service tests.

We manufacture Sheet and Tin Mill products for all purposes—American Bessemer Steel Sheets, American Open Hearth Steel Sheets, Keystone Copper Steel Sheets, Black Sheets, Special Sheets for stamping, Sheets for Electrical apparatus, Automobile Sheets, Deep Drawing Sheets; Apollo and Apollo-Keystone Galvanized Sheets, Corrugated Sheets, Formed Roofing and Siding Products, Culvert and Flume Stock; Long Terne Sheets, Roofing Terne Plates, Bright Tin Plate, Black Plate, Etc.

AMERICAN SHEET AND TIN PLATE COMPANY, Pittsburgh, Pa.



It Burns the Smoke!

by mixing it with a supply of super-heated air (oxygen) over the fuel bed. That's why the

CROWN
Fuel Saver

is warranted to save at least 20% of your coal bill and often does much more. Successfully used for 10 years.

We have just issued a detailed description of the Crown—if you are interested in saving fuel dollars, write for it today.

If you are buying coal for consumption in a factory, store, residence, apartment building, school, church, theatre or greenhouse, write us for proofs of what the Crown has saved under similar conditions.

DISTRIBUTORS WANTED. Responsible men are invited to write for interesting, exclusive territory proposition. We have a splendid sales plan for live distributors.

C. F. S. CO., 69 N. 10th St., Richmond, Ind.

Courtesy of "Slipstream Aviation Monthly"

Latest two-piece outfit for aviators made of fur and leather

collar and sleeves covered with plucked muskrat. Trousers, from hip to knee, have an extra covering of black dog hair. The hookless fastener provides a quick means of removal.

Courtesy of "Slipstream Aviation Monthly"

Aviator's suit open. The hookless fastening makes an easy removal possible

A Multiple Unit Motor

THE majority of forced landings for the airplane are due to motor failure. It is for this reason that multiple engine planes are so often constructed, in the hope that if one engine fails the remaining units will either enable the airplane to continue flight to its destination or at least allow so long and gentle a glide that the pilot will have no difficulty in finding a landing place.

Sheridan-Brompton Apartments, Chicago. *Architects: Rissman & Hirschfield. Contractor: Avery Brundage*

Soundproofing the Sheridan-Brompton

Unlike many other partition materials, gypsum is highly sound-deadening as well as fireproof and permanent. . . . That's why 131,860 square feet of Pyrobar Gypsum Partition Tile were used in the Sheridan-Brompton, one of Chicago's newest apartment homes. . . . Pyrobar Tile are light in weight, quickly and economically erected. Ask for descriptive booklets.

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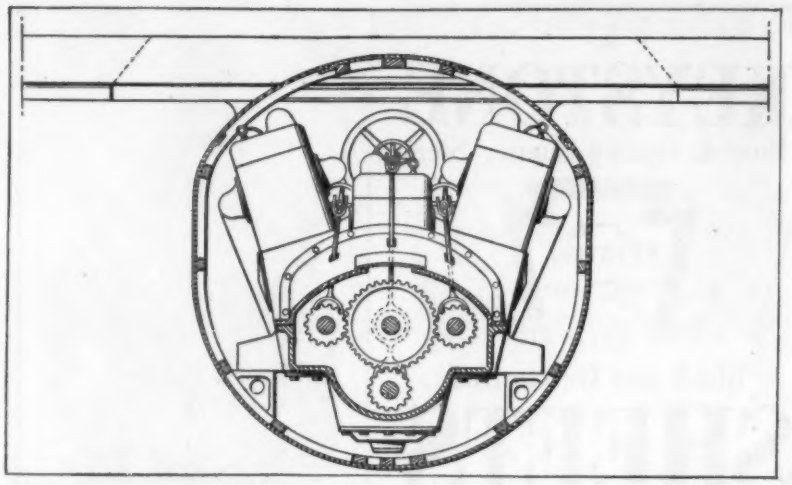
NOTE: Hard Maple can be had in *mixed shipments* with Beech, Birch and other desirable Northern Hardwoods. Write for list of member mills.



A compact, conventional type of airplane engine with three banks of cylinders, each bank having its separate gas ignition and radiator system and its own drive shaft geared to a main propeller shaft

The arrangement of two, three or more motors in a plane involves certain difficulties such as uneven propulsion when a propeller on one side of an airplane is stopped, however, and also tends to increase the head resistance.

The Germans during the later stages of the war built four motor units, all placed in the one fuselage, geared to the same propeller and capable of being thrown out or in at the will of the mechanic by a system of clutches more or less of the automobile type. The disadvantage here was the weight of the gearing and clutches which in German practice involved a weight of one to one and a half pounds per horsepower. Another suggested arrangement is the use of a motor with multiple banks of cylinders, each bank of cylinders having its own driving shaft, and each shaft being connected through a clutch and gears to the main driving shaft of a single propeller.

A correspondent, James V. Martin, sends us a brief description of such a device of his invention. This is illustrated in the two appended diagrams.

The first diagram shows a compact, conventional type of airplane engine with three banks of cylinders, each bank having its separate gas ignition and radiator system and its own drive shaft geared to a main propeller shaft as stated above. The second diagram illustrates the special mechanism whereby the three banks can be engaged or disengaged at the will of the pilot, or automatically disengaged when any one bank fails or lags behind. A long collar slides over the drive shaft of each row of cylinders.

A system comprising a threaded control rod, a lever arm, and pins working in slots permits the pilot to engage or disengage the teeth carried at the end of the collar with teeth in a clutch which drives a gear, in permanent connection with the large gear on the main propeller shaft.

The automatic control or release is provided by a spring in tension shown in the second diagram. If one of the engine units fails or slows down to an appreciable extent, the tension of the spring releases the clutch. (It is quite clear from the diagram that release by the spring is impossible if the collar is pressing its teeth fast and hard against the teeth of the clutch.)

The failure of one bank of cylinders, therefore, does not involve the stoppage of the whole engine. The amount of lag before automatic release is regulated at the will of the pilot. The ingenious mechanism is likely to be useful if no mechanical drawbacks occur in its execution. Particularly if, as stated, each row of cylinders is provided with an independent gas, ignition and water system the chances of total engine failure should be considerably reduced.

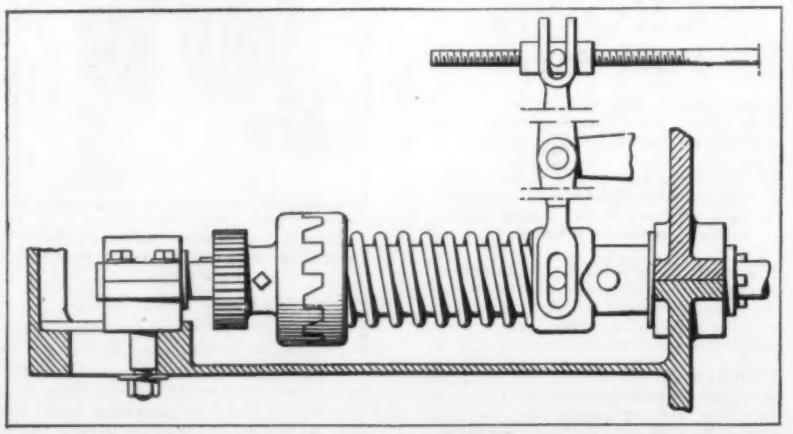
Can Everyone Fly?

IN the discussion of Dr. Heald's paper, Wing Commander T. S. Rippom gave it as his considered opinion that all normal adults under 45, who have not lived a purely sedentary life and strained their eyes by close work and are not unusually nervous should succeed in becoming *average aviators*.

The *super aviators* are individuals possessed with what is popularly known as the "flying temperament." They have good "hands," their reflexes are rapid and accurate, and they have a sort of instinctive foresight.

The *crasher class* can be detected by medical examination and comprise the erratic lander who suffers from defective vision; the individual who faints at altitude; those who get dizzy and lose control in a spin; those whose vision is dim at night; and those who are unable to stand fatigue.

The British Air Ministry insists on examination every six months and only if in perfect physical condition do pilots receive the "B" certificate in which the public and



The special mechanism of the conventional type of airplane engine whereby the three banks can be engaged or disengaged at the will of the pilot, or automatically disengaged when any one bank fails or lags behind. A long collar slides over the drive shaft of each row of cylinders

The "Piping Rock"—A Home Built On An Ideal!

THE "Piping Rock" Bungalow is built on an ideal of what a *real* home should be! Our many years of experience as builders of fine homes has contributed to its perfection.

The "Piping Rock" has won prize awards among home exhibits in almost every part of the country—it has received praise from owners and press alike. But the "Piping Rock" does not stop at being beautiful—it is just as substantially built, just as practical, as it is lovely.

Only quality materials, selected at the largest lumber plant in the East, go into construction of the "Piping Rock." It is a product of skilled craftsmanship, backed by our guarantee of satisfaction. The "Piping Rock" is delivered to you either *"sectional"* or *"ready cut"* as desired, complete with plans and specifications for erection. No skilled help necessary to put up the "sectional-built" home.

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Large, comfortable living room, 18 x 9 ft.; 2 light and airy bedrooms, with windows on three sides, 12 x 9 ft.; kitchen 6 x 9 ft. and bath 6 x 9 ft. Living room has casement doors at each end opening on pergolas. Pierced panel shutters on all windows.

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TIME was when an advertisement for a chauffeur was an almost unheard-of item in our daily newspapers. We have clipped the above ad from a recent issue of the *New York Times* because it happened to be the first one of its kind we had noticed; and, because we believe the time will come, when pilots and mechanics for passenger planes will be almost as much in demand as chauffeurs are today.

Young men in our colleges are choosing aviation for their profession and are studying for that work. We venture to predict that schools of aviation other than the army schools will be opening up in various sections of the country.

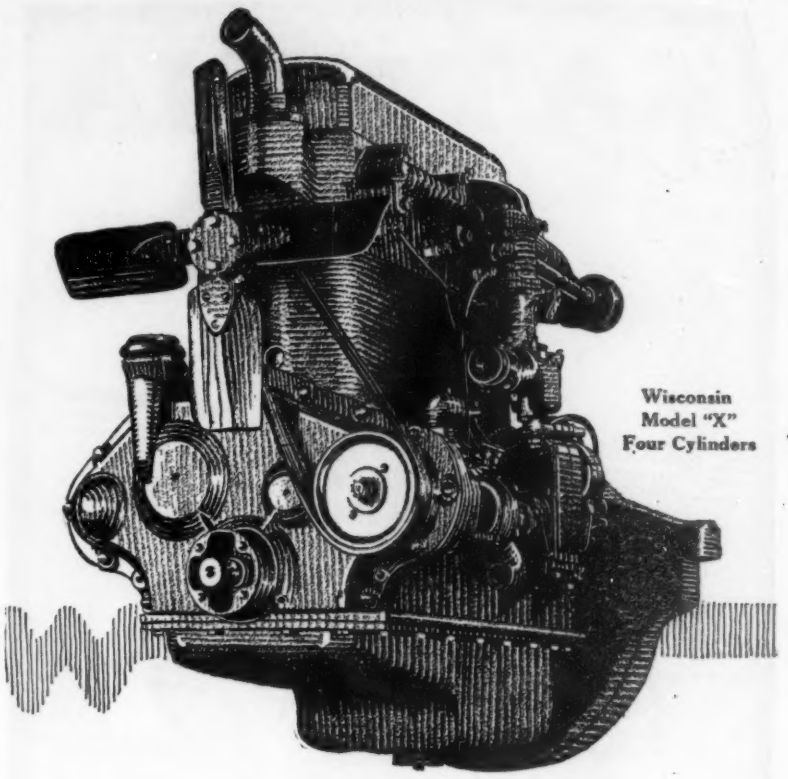
Air Sickness

DR. C. B. HEALD, medical adviser to the British Air Ministry, states very frankly in a paper before the Royal Aeronautical Society that air sickness or the fear of air sickness has deterred many hundreds from using air transportation regularly. American tourists who have made the London to Paris journey by air all concur in this view.

The problem is a difficult one. It cannot be solved by flying at great altitudes, by the use of drugs or even by "subtle soothing stomach strokings." The trouble is that ventilation of an enclosed airplane cabin is particularly difficult, because with the limited cubic space available for each passenger, if the air is changed sufficiently often to keep the carbon dioxide really low, a draught for some one is inevitable. If draughts are excluded the carbon dioxide content rises rapidly in so confined a space and the air becomes unpleasant. Under such conditions, particularly at meal times, air sickness is always perilously near.

The learned doctor suggests that there is work here for a committee composed of designers, medico-physiologists and susceptible passengers. Perhaps the designers alone can help. At any rate, they can build machines which are stable, but not so stable as to be thrown about violently in rough weather, and they should be able also to provide adequate heating, avoid draughts, yet provide plenty of ventilation.

The latest three-motored Handley-Page supplied to the Belgian Company "Sabena," provides decided improvement in these respects. Four rigid funnels, like those on a steamship are held outside the cabin, collect the cold fresh air and lead it into a tube on either side at the top of the compartment, the rate of admission being easily regulated. Warm, vitiated air is withdrawn at the bottom and rear of the cabin, openings being disposed where the sides of the fuselage are in suction. Hot-air pipes circulate underneath, the air being heated by the exhaust pipes of the central motor. This apparently simple system of heating and ventilation has taken the designers several years in its development.



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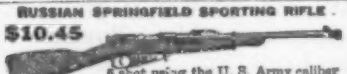

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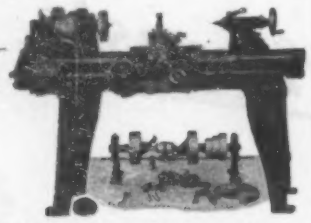

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Science and Money

Scientific Diversification of Investments

By Chase Donaldson

MONEY can be wisely invested only if scientific methods of selection are followed. The complexity of modern finance and the smoothly running banking machinery are as much the result of scientific study as is the latest oil-burning ship. Investors, therefore, to choose securities adapted to their individual needs, should first review the various classes of investment available. Then might well follow a carefully planned —and scientific—diversification of funds in proper proportions among these different classes.

Three Cardinal Principles of Investment

First, however, let us call to mind the three cardinal principles that should govern the selection of investments of whatever class. Safety, stability in market price, and ready salability must be considered above all else by the investor who wishes to avoid any semblance of speculation.

Safety is paramount to the person of moderate means, because the chance of losing any of his capital must be made as slight as possible. To insure safety, careful use must be made of all possible sources of information, and of the advice and opinion of one's bank. Furthermore, funds should be placed only in recognized and suitable mediums of investment, and never in new ventures or little known enterprises.

Stability—the absence of wide fluctuations in market price—should be considered in order to avoid possible loss through the necessity of selling at an inopportune time. In addition, competent advice must be sought as to whether it is a good time to buy or invest, or whether values have reached a particularly high point.

Salability—the existence of a ready and a known market—is of most importance to those who may be called upon to draw upon their invested capital for funds. Others, however, who are mainly interested in a steady income, need not be so concerned about the question of marketability.

These three principles may seem so elementary as to be common knowledge; but the safe deposit boxes of many wealthy men have disclosed a disregard of elementary principles that has proved serious. "Cats and dogs" is the slang name for securities which have proved worthless, and one has but to read the auction notices of securities to be sold to discover the number of such worthless investments made by intelligent but careless investors.

Savings Accounts the Starting Point

Principles of investment remain unchanged, but the forms of investment now available vary over a wide range. Again let us start with a simple classification, and then let us work into the more complex subject of the kinds and varieties of bonds on the market.

Savings bank accounts for those in modest circumstances are of necessity the starting points for more ambitious transactions. Such an account is the embodiment of the three principles first indicated. It is safe, because of state regulation and supervision, which limit the kinds of investment that the bank can make to the highest possible grade of securities. It is stable, because the original amount of the principal is always protected. And it is readily "salable," because it can be drawn upon at any time.

Life insurance, the next classification of investment, is in substance the same as a savings bank account, with the added element of protection in the event of death. Few realize that actually one receives as much interest on a life insurance policy over a long period of years as might be obtained from a savings bank account. In other words, one can take the "cash surrender value" of a policy after a number of years, and this amount will be a total of the sums paid as premiums, plus interest at from three to four percent or better.

Securities, on the other hand, cannot be accepted with the same confidence that one is justified in reposing in savings banks and life insurance. Bonds and stocks demand much serious study before any purchases are made. In the case of industrial securities, one must inquire—just as do all reputable investment bankers—into a number of aspects surrounding the industry.

The significant questions to be asked are not difficult to remember: is the industry a permanent, necessary one; does a good market exist for its product; is its location advantageous as regards raw materials and markets; is the management of a high order; is the financial condition of the company sound, from the point of view of earnings, depreciation, working capital, and bonded debt? Of course, it is not always possible to take the time to look up these points—and others more technical as well—but a large measure of confidence may be placed in the representations of established and reputable investment bankers.

Classification of Bonds

Bond names are indeed confusing, and the degrees of security are as varied as are the names. In the first place, the designation "registered" or "coupon" indicates how the interest will be paid. If registered, that particular bond stands on the books of the registrar in the owner's name, and it can be sold only after indorsement of the bond, and notification of the registrar. The interest on such a bond is paid by check direct to the owner of the bond. A coupon bond, on the other hand, is readily negotiable without endorsement, and interest checks or coupons are attached to the bond. Registration is a form of insurance against losing the bond, but a coupon bond can be sold without any delay.

Bonds are a direct obligation of the company issuing them, and are usually secured by a lien or claim on specific property or assets. Notes and debentures, though, are unsecured obligations and are dependent upon the credit standing of the company rather more than on the value of a specific piece of property.

First mortgage bonds, or first and refunding mortgage bonds, usually have a direct claim on specific property; first lien bonds are for the most part second mortgage issues, which are preceded by other bonds. Collateral trust bonds and notes are not a lien on specific property, but are secured by the deposit of securities with a trustee. These securities, however, may be only stocks, or may be bonds which in turn are first or second mortgages on property. Combinations of the above names may often be found, as, "first lien and collateral trust" or "secured gold bonds" or other names which may or may not disclose the true nature of the bond or note. As an arbitrary measure, it is often true that the closer a bond is to being a first mortgage of a given company, the lower the rate of interest return that will be received.

To sum up, bonds are nothing but evidence that the bond holder has made a loan to the company which it promises to pay back at a certain time, and for which it agrees to pay a certain rate of interest from time to time. A bond holder is a creditor and can sue or foreclose if he is not paid his interest or his principal.

Classification of Stocks

Stocks, on the contrary, are evidences of ownership in a company, and the dividend received depends upon the profits made. A

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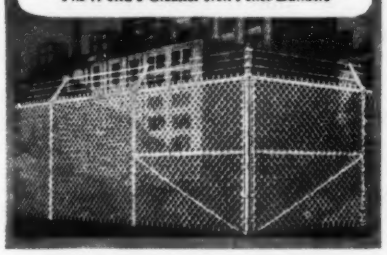

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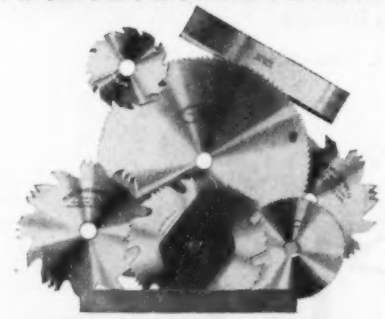

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stockholder, though, is not liable for the debts of a corporation, except in special cases. Preferred stocks, as distinguished from common or capital stocks, simply entitle the holders to a definite rate of dividend when declared, before the common is entitled to receive any return. Also, a preferred stock is entitled to be paid a stated value in case of dissolution, or in case the stock is "called."

Common stocks retain the sole voting power in most cases. If dividends are passed on the preferred shares, however, those shareholders are given voting power according to certain conditions. Common stocks receive larger dividends in prosperous times, but are subject to the passing of dividends in bad times. A recent tendency in financial circles has been to create two classes of common stock, an "A" stock and a "B" stock. Such an "A" stock is similar to a preferred stock that participates in the earnings on the "B" stock. The conditions surrounding the payment of dividends on common stocks, which have these two classes of stocks, should be carefully examined to make sure of one's position.

Diversify Your Investments

Scientific diversification of investments, to round off this brief review, means the careful distribution of savings among the classes of investment touched upon. The proportionate amount that should go into each class depends entirely upon the individual circumstances. The man who can save but relatively few dollars each year should depend upon the savings bank and upon insurance. The investor who has but a moderate amount available still needs his savings bank account, for his children, if not for himself, and certainly insurance. The balance of his funds should go into the best grade of bonds, with a small amount in standard preferred or common investment stocks.

How large a proportion of the funds of the wealthy man should be placed in bonds—tax exempt or otherwise—is to some extent dependent upon the income tax bracket in which he falls. The fluctuating value of the dollar, however, has raised another equally important consideration. The money return from bonds is fixed, but the purchasing power of that money varies. Therefore, the argument has arisen that common stocks should be purchased for long term investments, because the dividends are higher in prosperous times when the purchasing power of the dollar is declining. Investors who are interested in this particular question will find an extensive discussion in "Common Stocks as Long Term Investments," by Edgar Lawrence Smith (The Macmillan Company).

In the last analysis, each investor must consider these rather elementary financial topics in the light of his own knowledge and finances. Here again, however, a bank or a highly regarded investment banking house can be consulted on the ideal degree of diversification to be observed between a savings bank account, insurance, bonds of different kinds, and stocks.

Science Notes

Will the Human Race Hunger?

"THE question of food will be the dominant one to be met by the ingenuity of man in future ages," J. B. Kincer, of the U. S. Weather Bureau, predicted in an address before the American Meteorological Society.

Mr. Kincer pointed out the dependence of food upon favorable climate, and discouraged the belief that the geographic distribution of rainfall can be changed through the influence of cultivation.

Man must sustain himself from a very small portion of the earth's surface. Three-fourths of it is water and of the remaining land a very large percentage is unsuited for profitable agriculture. In the western half of the United States, southern Russia, western China, and over vast areas within the tropics, limitations to intensive production

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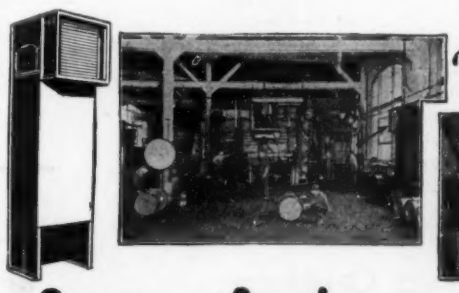

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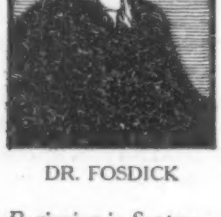

DR. FOSDICK

Beginning in September, Dr. Fosdick creates a monthly department — Religion and Life — in Harper's. These articles will have nothing to do with creeds or controversies. Their scope is as wide as life itself. Vital religion, Dr. Fosdick says, is one of the three deepest needs of man, and he talks of it as an urgent present power desperately wanted by men and women everywhere.

WITH the September number comes a new Harper's Magazine. This national institution, which has seen so many changes and has itself changed many times to maintain its position as leader of American thought, has taken another of these important steps. A fundamental one, this time, involving not only a change in physical aspect, but a distinct development in editorial policy.

A vividly arresting cover, a perfect type page, a frontispiece in color, actually more reading matter than before—these are characteristic of the new magazine.

The editorial forecast of the new Harper's promises a magazine of infinite variety, of stimulating and authoritative articles, masterful fiction, provocative and exhilarating approaches to numerous aspects of this extraordinary universe.

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IN THE SEPTEMBER NUMBER

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THUNDER ON THE LEFT, *by* CHRISTOPHER MORLEY
THESE AMERICAN MEN, *by* REBECCA WEST
SHOULD MARRIAGE BE MONOTONOUS?, *by* ELTON MAYO
THE ARISTOCRATIC WEST, *by* KATHARINE F. GEROULD
THE WIFE OF ABRAHAM LINCOLN, *by* GAMALIEL BRADFORD
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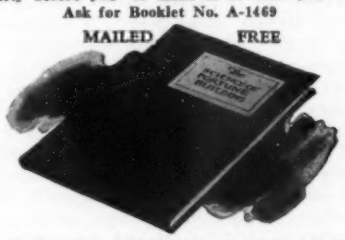

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are imposed by scanty moisture; while in the northern portions of the northern hemisphere, and in the higher elevations of middle latitudes, the limiting factors are low temperatures and a short growing season.

More than one-half of the land area of the globe receives less than 20 inches of precipitation annually, and only about one-fourth receives those amounts that are best suited for agricultural purposes, namely, between 20 and 50 inches. Of this one-fourth part, moreover, large areas are unsuited for cultivation, because of mountains or because of low temperatures in more northern localities, and high elevations.

Outside the temperate and tropical zones, the temperature conditions are generally unfavorable for plant growth, and of the 52,000,000 square miles of land within these zones, only about 20 percent is potentially arable, a little more than half of which is, at the present time, cultivated or used for pasture. The world's food supply from cultivated crops is now produced on approximately seven percent of the land.

In recent centuries, the population of the world has increased rapidly. The question of sustenance for the multiplied millions has been taken care of by migration to less densely populated countries, principally the Americas, and by importation from foreign lands of plenty. By this process the unoccupied arable land of the world has been gradually taken up until today very little remains in regions with healthful climates.

The Americas are the world's last food frontier. When they shall have reached their maximum production, if populations continue to increase as in the recent past, a serious situation will be presented.

Why Wood Is Weakest Sidewise

CELLULOSE, whose chemical structure has baffled chemists for a century, is yielding to the searching eye of the X-ray spectrograph in the hands of Dr. O. L. Sponsler, botanist of the University of California. The most recent photographs show that cellulose—a stick of wood for example—consists of a multitude of strings of molecular beads all running parallel.

Many years ago chemists discovered that cellulose consists of carbon, hydrogen and oxygen in the proportion of six, ten and five atoms, respectively. Little more is known of its chemical architecture. Cellulose does not crystallize, vaporize, melt or do any other orthodox act which would help out the analytical chemist. In the light of X rays, however, it now yields a series of remarkable line photographs which indicate the bead-string style of structure.

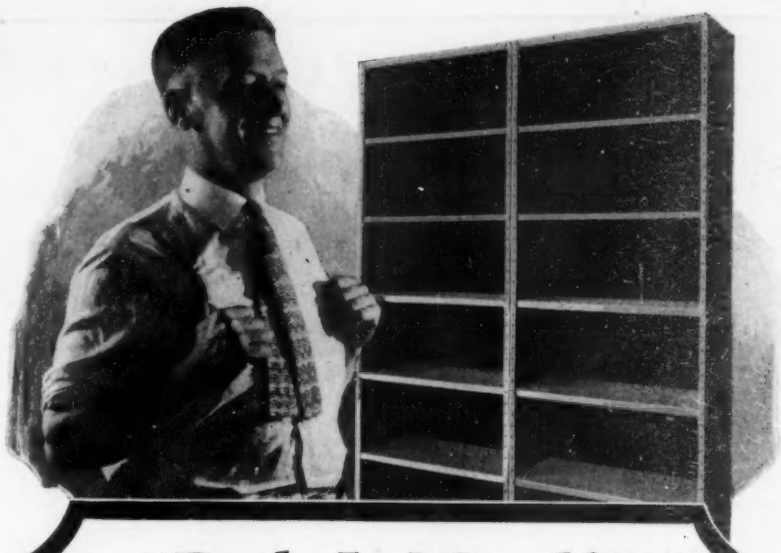
The "beads" are all alike. Each apparently consists of a cluster of twenty-one atoms firmly combined like an individual chemical molecule, but still chemically tied to its two neighbors in the spring, above and below. It requires about fifty millions of these atoms, end to end, to span the distance of one inch.

Ordinary light waves are too coarse to reveal such minute details, so that there is no hope of seeing the atoms, even through a powerful microscope. The minute X rays, however, are able to pick out and exhibit to the camera such atomic details as those just described.

Dr. Sponsler pictures the cellulose units acting as beads closely strung on a tight cord. The chain resists a pull better than a push. This agrees nicely with the well-known principle that a timber will withstand a greater tensile stress than a crushing stress.

The bead chains, being separate, can easily spread apart without breaking. This also agrees with the fact that a timber, soaked in water, will swell sidewise but not lengthwise.

The new theory also tells us that a broken strand of cellulose should have reactive atoms at the ends of the chains, where the rupture occurred, and where there is obviously no material to hang on to the last link. This agrees with the known fact that certain chemical tests work on the end of a fiber, but do not succeed on the side.



"Built It Myself!"

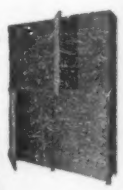
VAN DORN Convertible Steel Shelving is almost *too* easy to erect. Makes a fellow feel proud and foolish at the same time. Proud to think you were the builder. Foolish to think you ever worried over old fashioned wood shelving.

Just consider what you can do with Van Dorn Convertible Steel Shelving! With a wrench and screwdriver (the only tool necessary) you can quickly assemble any size and style of shelving you need. When you wish to change it to meet new requirements "it's like putty in your hands."

Master your shelving problems with Van Dorn Convertible Steel Shelving! We *know* you'll like it!

Catalog? Most certainly you want it!

The Van Dorn Iron Works Co.
Cleveland, Ohio
Branches: Cleveland - New York - Chicago - Washington - Pittsburgh



Van Dorn
MASTERCRAFTSMANSHIP IN STEEL

BANCA LOPEZ QUESADA

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Capital 10,000,000 Pesetas

Desire exclusive Agencies in Spain of American Manufacturers and Inventors of patented goods. Would also buy patents for manufacturing in Spain.

Barnes

Runs from lamp socket

BARNES
Electric Bench Scroll Saw
Not a Toy but a practical Tool.
Price includes boring attachment, Emery Wheel, etc.
W. F. & JOHN BARNES CO.
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WANTED

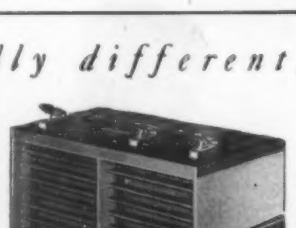
Men to manufacture Metal Toys and Novelties. Good chance to start your own well paying business producing such big sellers as Toys, Novelties, Ash Trays, Book-blocks, Souvenirs, Advertising Specialties, Paper Weights, etc. We furnish forms with complete outfit for speedy production. Absolutely no experience or tools necessary; no special place needed. Small investment puts you on road to success. Demand exceeds supply and we assist and cooperate with our manufacturers in selling their products. We put you in touch with the buyers and assure an outlet for your goods. Strictly a business proposition and thoro investigation invited. A splendid opportunity for an enormous and profitable business for ambitious men. No others need apply.

Catalog and information mailed on request

METAL CAST PRODUCTS CO., 1696 Boston Road, New York

NEW! *Radically different!*

No. 486 Eveready Layerbilt "B" Battery. 45 volts. Length, 8 3/16 inches. Width, 4 7/16 inches. Height, 7 3/16 inches. Weight, 14¼ pounds. Price, $5.50.



It's all battery. With every cubic inch packed to capacity, it contains about 30 per cent more electricity-producing material. All chance of loose or broken connections avoided by contact of full area of carbon plate against zinc plate. The scientifically correct construction.

The greatest improvement ever made in "B" Batteries

ABSOLUTELY new in construction—perfected through years of research, the new Eveready Layerbilt "B" Battery is as superior to the old type "B" Battery as a tube set is to a crystal.

Heretofore, all dry "B" Batteries have been made up of cylindrical cells—no one knew how to make them any other way. The new Eveready Layerbilt is made of *flat* layers of current-producing elements compressed one against another, so that every cubic inch inside the battery case is completely filled with electricity-producing material. Layer-building heightens efficiency by increasing the area of zinc plate and the quantity of active chemicals to which the plate is exposed.

After the most rigid laboratory tests, more than 30,000 of these new Eveready Layerbilt "B" Batteries were manufactured and tested by use under actual home receiving conditions. These tests proved that this new battery is far superior to the famous Eveready Heavy-duty Battery No. 770, which up to now we have ranked as the longest lived "B" Battery obtainable.

On 4-tube sets, 16 mil drain, it lasts 35% longer.
On 5-tube sets, 20 mil drain, it lasts 38% longer.
On 6-tube sets, 24 mil drain, it lasts 41% longer.
On 8-tube sets, 30 mil drain, it lasts 52% longer.

The new Layerbilt principle is such an enormous stride forward in radio battery economy that we will bring out new sizes and numbers in this Layerbilt form as fast as new machinery is installed. For the present, only the extra-large 45-volt size will be available.

Buy this new Eveready Layerbilt No. 486 for heavy drain service. It far exceeds the performance for which Eveready Radio Batteries always have been famous and is, we believe, the most economical of all sources of "B" current.

Manufactured and guaranteed by

NATIONAL CARBON COMPANY, INC.
New York San Francisco
Canadian National Carbon Co., Limited, Toronto, Ontario

EVEREADY HOUR EVERY TUESDAY AT 8 P. M.
Eastern Standard Time
Beginning September 29th, 9 P. M. *Eastern Standard Time*
For real radio enjoyment, tune in the "Eveready Group." Broadcast through stations—

WEAF	New York	WFI	Philadelphia	WEAR	Cleveland	WCCO	Minneapolis St. Paul
WJAR	Providence	WGR	Buffalo	WSAI	Cincinnati		
WEEI	Boston	WCAE	Pittsburgh	WWJ	Detroit	WOC	Davenport

EVEREADY
Radio Batteries
—they last longer

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Underwood & Underwood

Hal H. Smith, newspaper correspondent in Washington, has picked up 165 stations in 30 States. The wave trap on top of the cabinet is the secret of his success. One terminal of the trap connects to an outdoor antenna and the other terminal goes to the ground. There is no direct connection between the trap and the superheterodyne. Energy intercepted by the outdoor wire is transferred to the inside loop by induction. The set is tuned as usual and then the wave trap is tuned until the signal is loudest

Measurements Show Reception Excellent on Pacific Coast

THE Transmission Research Laboratory, conducted jointly by the Bureau of Standards and the American Section of the International Union for Scientific Radiotelegraphy, has been investigating the question as to how strong an electric field is produced in California by long-wave high-power radio stations on the other side of the Pacific. For this purpose, measurements were made by Dr. L. W. Austin of the Bureau of Standards in San Diego on the arc stations at Cavite, Philippine Islands, and Malabar, Java, which lie respectively about 7,500 miles and 9,400 miles from San Diego. These are the greatest distances attainable by daylight over water with the present distribution of high-power stations.

The signals were measured by comparing them in the telephones with signals from a local generator of known strength. To keep out interference from the Eastern stations and to reduce static it was generally necessary to receive the signals on an undirectional antenna and coil combination. On account of the great difference in time between San Diego and Cavite (eight hours) and Malabar (nine hours), it was possible to observe only about two hours of the day without getting too near the sunrise or sunset at either the sending or receiving stations.

The average field intensity produced by Cavite was 2.04, and Malabar 4.02 microvolts per meter. These received signals are very feeble compared with those received in transatlantic radio communication, which generally vary between 20 and more than 100 microvolts per meter.

Schedule of Radio Expositions

SEPT. 5-12—Third Annual National Radio Exposition, Ambassador Auditorium, Los Angeles, Calif.

SEPT. 12-19—Fourth Annual National Radio Exposition, Grand Central Palace, New York City.

SEPT. 14-19—Second Annual Radio World's Fair, 258th Field Artillery Armory, New York City.

SEPT. 14-19—Pittsburgh Radio Show, Motor Square Garden, Pittsburgh, Pennsylvania.

SEPT. 14-19—Radio Show, Royal Alexander Hotel, Winnipeg, Canada.

SEPT. 21-26—Radio Trade Exposition, City Auditorium, Omaha, Neb.

SEPT. 23-27—International Radio Exposition, Atlantic City, New Jersey.

SEPT. 23-OCT. 4—International Radio and Wireless Exhibition, Geneva, Switzerland.

SEPT. 28-OCT. 3—National Radio Exposition, American Exposition Palace, Chicago, Illinois.

OCT. 3-10—Radio Exposition, Arena, Philadelphia, Pa.

OCT. 5-10—Northwest Radio Exposition, Auditorium, Minneapolis, Minn.

OCT. 5-11—Washington Radio Show, Convention Hall, Washington, D. C.

OCT. 10-16—National Radio Show, City Auditorium, Denver, Colorado.

OCT. 12-17—Boston Radio Show, Mechanics' Hall, Boston, Massachusetts.

OCT. 12-17—St. Louis Radio Exposition, Coliseum, St. Louis, Missouri.

OCT. 17-23—Brooklyn Radio Show, Twenty-third Regiment Armory, Brooklyn, New York.

OCT. 19-25—Radio Exposition, Music Hall, Cincinnati, O.

NOV. 2-7—Radio Show, King Edward Hotel, Toronto, Ont.

NOV. 7-15—Radio Exposition, Public Hall, Cleveland, Ohio.

NOV. 9-15—Milwaukee Radio Exposition, Civic Auditorium, Milwaukee, Wisconsin.

NOV. 17-22—Second Radio World's Fair, Coliseum, Chicago, Illinois.

NKF Reaches Mediterranean

THE yacht *Scorpion*, recently on tour in the Mediterranean, picked up the signals from station NKF, Bellevue, every night on a short-wave receiver built by the radio men on board. The operators said that the signals of NKF were louder than those of the high-power transmitter at Annapolis. The receiver consisted of one tube; five turns of wire were used on the primary; twelve turns on the secondary and ten on the tickler. The antenna was twelve feet long.

United States and Venezuela Linked by New Ether Channel

A NEW commercial radio circuit has been opened between the naval station at San Juan, Porto Rico, and Caracas, Venezuela, for handling messages between the United States and Venezuela. The total rate on commercial dispatches between the two points is twenty-four cents a word. The rates for commercial messages between other points in the United States and Venezuela will be those of the land lines or cable between the point of origin in the United States and San Juan, plus the rate of twenty-four cents a word plus the rates of the land lines from the Venezuelan station at Caracas to the destination or *vice versa*.

NSS and NPL Sending Time Signals Daily

STATIONS NSS, Annapolis, and NPL, San Diego, are sending 75th Meridian time signals and will continue the service until September 30th. San Diego sends at 5:55 A.M. daily and Annapolis at 2:55 A.M. Extremely high wavelengths are used so that the signals are out of range of the ordinary broadcast receiver. These time ticks are transmitted especially for surveyors operating in the United States, Alaska and Canada. One party is surveying the western extremities of the Aleutian Islands, off Alaska.

Tennessee Transferred to Fourth Radio District

THE State of Tennessee has been transferred from the Fifth Radio District (New Orleans) to the Fourth District, under the jurisdiction of the radio supervisor at Atlanta, Georgia. Applications for any class of license for Tennessee must not be submitted to Atlanta instead of New Orleans. Amateurs in Tennessee, formerly assigned call letters beginning with "5," indicating the fifth district, will hereafter be assigned calls beginning with "4." Existing licenses in Tennessee will also be changed to begin with "4."

Naval Radio Service Testing Low-Wave Sets on Land and Sea

THE Naval Radio Service has eleven short-wave transmitters of which there are seven ashore and four afloat, in addition to twenty-five low-wave receivers on land and sea. The land stations are located at Bellevue, D. C., Quantico, Virginia, Lakehurst, New Jersey, San Diego, San Francisco, California, and Great Lakes, Illinois.

The Washington Navy Yard has a transmitter operating between 20 and 80 meters. Vessels equipped with short-wave installations are: *New Mexico*, *Los Angeles*, *Canopus* and *Sturgeon Bay*, operating between 40 and 150 meters. Guam recently heard NKF, Bellevue, transmitting with a five-kilowatt output.

Bequest Provides for Two Stations

A BEQUEST of $100,000 has been given to the University of Illinois and Notre Dame University by Boetius H. Sullivan, in honor of his father, the late Roger C. Sullivan, Chicago Democratic leader, for the purpose of building two broadcasting stations. Each station will also receive $8,000 for maintenance. It is expected that both stations will have studios in Chicago and that broadcasting will begin before the fall.

EAGLE

Know Ye All Men By These Presents

New Models-

Superlatives and adjectives are not adequate to describe
THE NEW EAGLE RECEIVERS

Suffice Therefore to State That

In APPEARANCE—PERFORMANCE—and
STABILITY, THEY HAVE NO PEER

Write for Beautiful Booklet Entitled

Radio At Its Best

From its descriptive illustrated pages you can select models most adaptable to your needs, then go to an EAGLE DEALER, where a demonstration will convince.

Old Policies

A careful selection and limited appointment of dealers—thereby assuring **Courteous** and **Efficient Treatment** to you.

Production in harmony with quality, which sets a **Standard** of **Excellence** on each individual Receiver.

A **Sales** and **Service Campaign,** the combination of which insures against a depreciation of your investment.

A **Weekly Broadcast** of **Talented Artists** who furnish you with **Quality Entertainment,** under the title of EAGLE **Neutrodyne Trio,** from **Station WEAF** New York City.

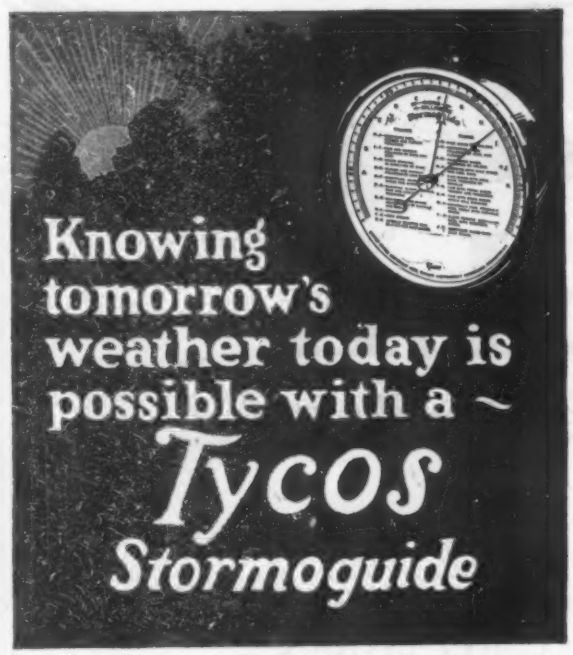
A TRADEMARK OF QUALITY

WE SOAR ABOVE
EAGLE RADIO COMPANY
NEWARK NEW JERSEY

ASK YOUR NEIGHBOR

Eagle Radio Company

16 BOYDEN PLACE NEWARK, N. J.



Will it be rainy, windy, cloudy or clear at dawn when you start out on that game of golf or fishing trip? If you had a *Tycos* Stormoguide you could plan 12 to 24 hours in advance. A scientific instrument of proven worth. May we send prices and more information? Ask for Stormoguide Booklet on a postal or go to your dealers and get one.

THERE IS A TYCOS OR TAYLOR TEMPERATURE INSTRUMENT FOR EVERY PURPOSE

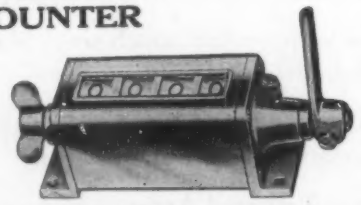
Taylor Instrument Companies
ROCHESTER, N. Y., U. S. A.
CANADIAN PLANT TYCOS BUILDING, TORONTO

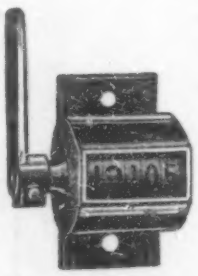
From High Records—High Standing

Your machine stands high by *test of use* when it makes high records on a Counter. *There* you read its value as a producer. *There's* the testimony of performance. For proof of the working of any machine, any development *or* new design, point to the final answer on a

Veeder
COUNTER

The large Set-Back Revolution Counter at right is shown less than ½ size. The small Revolution Counter below appears nearly full size.





The Re-Set Revolution Counter above records the output of the larger machines where the revolution of a shaft registers an operation. Counts one for each revolution, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, according to purpose. Price, with four figures, as illustrated, $10.00 (subject to discount).

The Small Revolution Counter at left records the output of smaller machines where a shaft revolution indicates an operation. Though small, this counter is very durable; its mechanism will stand a very high rate of speed, making it especially adapted to light, fast-running machines. Will subtract if run backward. Price, $2.00.

EVERYTHING you need in a counting device goes to make up the full-line Veeder booklet. Production Counters, Speed Counters, Hand Tally Counters and others. Copy free.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

Transoceanic Low-wave Circuit Used by Shipping Board

THE Shipping Board is using a short-wave circuit between Bellevue, D. C., and London, through the cooperation of the Naval Communication Service. Shipping Board European traffic, approximately 1,000 words a night, is handled on the 71-meter wavelength. The power output is nine KW. A large loop on the roof of a building in London intercepts the waves radiated from Bellevue.

Wireless Detects Thieves

A GERMAN inventor has produced what he terms a "radio thief catcher." It is an electrical wired gateway at the entry of factories and mines. The gatekeeper near-by wears a radio headset and he listens when a workman passes out of the gate. The electrical system is adjusted so that if a workman brings an extra amount of metal through the gate a noise is heard in the phones. Thus, any metals concealed about a workman over a certain amount is immediately detected. In this way employes are prevented from carrying away precious metals or tools. The apparatus is tuned so that a reasonable amount of metal such as coins, pocket knives and watches do not create a signal.

U.S.S. Saratoga Can Use Only One Antenna Mast

THE *U.S.S. Saratoga*, the most powerful electrically driven ship in the world, equipped to carry 72 airplanes, has an elaborate radio installation. The fact that it is a carrier of aircraft makes it necessary to have decks almost unobstructed by masts and antenna wires. The aerial is held aloft by a single mast which can be lowered should the ship ever pass under the Brooklyn Bridge. Constant radio communication can be maintained with the airplanes and the ship.

Radio Show at Atlantic City

AN international radio exposition is scheduled to be held from September 23 to 27 on the steel pier at Atlantic City. The show will be under the auspices of the third radio district and the Radio Trades Association.

Headsets for Train Passengers

THE Great Northern Railway's plan for radio entertainment on its transcontinental train, the Oriental Limited, involves the elimination of the loudspeaker. Headsets will be attached to each chair of the observation parlor and in each compartment so that the radio entertainment will be disseminated only to passengers, who may want to listen. It was found that the loudspeaker disturbed those who wanted to play cards, read or amuse themselves without interference. The programs are picked up with a superheterodyne connected with a loop antenna.

High Power for KYW

THE new KYW atop the Congress Hotel, Chicago, is similar to the apparatus used at KDKA. The old KYW transmitter has been retained for emergency purposes.

WGY Uses Four Waves

IN order to afford experimenters an opportunity to compare the same program under similar conditions, but with differences in power and frequency, WGY, Schenectady, now broadcasts all of its programs on four different wavelengths. The broadcasts can be heard on the following: WGY, 379.5 meters; 2XAF, 38; 2xK, 109; and 2XAH, 1,660. The last three calls are for experimental purposes, under licenses granted the General Electric Company. The experimental stations are in the transmission laboratory three miles from Schenectady.

Radio fans equipped to detect the variety of wavelengths are asked to report to the engineers, especially, in regard to quality,

PANTLIND HOTEL
Grand Rapids, Mich.
750 Rooms

YOU can count, on the fingers of both your hands, all the hotels in the United States equalling in facilities and service the standard maintained at Pantlind Hotel. Small wonder, then, that those who best know Grand Rapids should stop invariably at this comfortable, friendly hostelry. Outstanding in structure, equipment, policy — and equally outstanding in the excellence of its several restaurants. Rates from $2.25 up; with private bath $2.50 up.

Fred Z. Pantlind, *Pres. and Mgr.*

BECOME A FOOT CORRECTIONIST

$3,000 to $10,000 yearly in a business of your own, —many are making it in the New Profession of foot correction, not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.
STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

Amateur Mechanics—Model Makers—Students
Wade Bench-Lathe

Cap: 4" dia. x 12" length. Slide-rest has travel entire length of bed. Leadscrew inside bed. Hollow spindle. Turning, facing, boring, drilling, winding, thread-cutting.
No. 1 Lathe, plain headstock . . . $28.00
No. 2 Lathe, back-geared headstock . . . $58.00
Complete line of accessories at equally low prices. Write for interesting free literature.
THE GERGLD COMPANY
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Experimental and Model Work
Fine Instruments and Fine Machinery,
Inventions Developed.
Special Tools, Dies, Gear Cutting, Etc.
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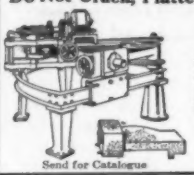
"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe
Standard of the World
Hand and Motor Operated
14 Sizes of Machines



What it costs to bend pipe our way, per bend:
1-inch pipe . . . . . 5 cts
2-inch pipe . . . . . 10 cts
4-inch pipe . . . . . 25 cts
6-inch pipe . . . . . 60 cts
8-inch pipe $1.00
American Pipe Bending Machine Co.
Send for Catalogue 32 Pearl St. Boston, Mass.

A Revelation in Tone—Volume—Clarity

The Kellogg Symphony Reproducer brings the broadcasting studio into your very room, so realistic is its reproduction.

Piano music, the most difficult to reproduce, sounds so natural that you are completely carried away by its beauty.

Vocal selections retain all of the tone colorings of the artist.

Orchestra music is indeed a recreation, every instrument can be heard, clear and full.

Magnetic diaphragm control—used exclusively in the Kellogg unit—is the new principle that performs wonders in radio reproduction.

Nothing like it at twice the price—$20.00 each.

At your dealers—Hear one today.

The Kellogg Switchboard & Supply Co.
1066 W. Adams St. - - Chicago, Ill.

If You Took Your Radio Tubes to the Jeweler's

And asked him to clean the corroded terminals, he would reach for a NICHOLSON X. F. Swiss Pattern File and, applying it lightly to the prongs of the tube, quickly assure a good clean contact.

You, of course, can do this as well for yourself and for all other fine filing should keep on hand NICHOLSON X.F. Swiss Pattern Files, the kind jewelers use for the most exacting work.

That we could take the skill of the old Swiss file makers—improve on it—and inject it into mass production, seems almost impossible.

But the sharp teeth, the perfect temper, the balance and the amazing uniformity of the X. F. Swiss Pattern Files, plus the verdict of the craftsmen who use them, prove that this has been done.

EXTRA X.F. FINE

SWISS PATTERN FILES

—a File for Every Purpose

NICHOLSON FILE CO.
PROVIDENCE, R. I., U.S.A.

fading, static, and strength of the signals. For example, if the 38-meter signal is heard clearly, while the 379.5 meter wave fades or is blasted by static, the research men will be very much interested in hearing about it.

The aerials used in radiating on the wave band from 15 to 200 meters are held aloft by wooden masts, while steel towers 300 feet high support the wires connected with the higher wave apparatus.

The power plant includes a number of high-powered rectifiers for converting the alternating current supply into direct current with a maximum voltage of 30,000. The space allotted for the two transmitters is sufficient for equipments rated at a maximum ranging from 50 to 100 kilowatts. The power building also includes a dark room, for developing of oscillograms, and a storage battery plant. Here also is located a central pumping system which provides circulating water for cooling the high-power vacuum tubes.

Navy's Low Waves Have Long Range

THE United States Navy's short-wave transmitter with the Pacific Fleet has communicated with over 100 amateurs in all corners of the country and has been heard in Paris on 40 and 54 meters. This was accomplished with slightly more power than consumed by the average electric iron. The call letters NRRL, on 20 meters, were heard in broad daylight in Pennsylvania, eastern Canada and the Mississippi Valley.

Ice-cream Refrigerator Causes Interference

LISTENERS in Danville, California, were troubled with widespread interference and the Vigilance Committee of the American Radio Relay League was called in by the radio fans. An investigation revealed the commutator on a motor in an ice cream parlor refrigerator was sparking and producing the interference.

Stations on Great Lakes Have New Wavelengths

COMMERCIAL ship and land stations on the Great Lakes are now using the 715 and 875-meter wavelengths, instead of 300, 600 and 706 meters.

Special Call Signal

THE call letters BXA is a general signal designating any British naval coast station.

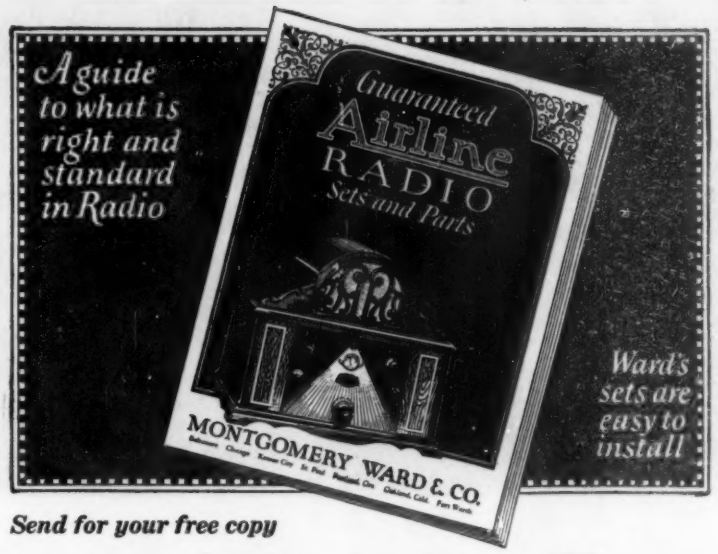
New Ether Circuit

A DIRECT radio circuit has been opened between the United States Naval station at Tutuila, Samoa, and the French station at Papeete.

Radio Pictures in Color Foreseen by Jenkins

C. FRANCIS JENKINS, radio photographic experimenter of Washington, has succeeded in demonstrating apparatus by which moving objects, including a Dutch windmill and motion picture film, were sent by radio for five miles and reproduced on a miniature screen, ten by eight inches. The transmitter was set-up at station NOF, near Anacostia, D. C., and the receiver in the Jenkins' laboratory in Washington. He predicts that the process will be perfected so that scenes at baseball games and prize fights can be broadcast over long distances.

Mr. Jenkins believes that some day it will be "easy" to radio pictures in their natural colors. "It is well known that pictures in color are in common use in magazine printing, in window transparencies and decorations," he explains. "The process consists of making three negatives, one through a red screen, a second through a green screen and the third through a blue screen. When transparencies from the three negatives, each stained with its complementary color red, green and blue, are superimposed and viewed by transmitted


A guide to what is right and standard in Radio
Guaranteed Airline RADIO Sets and Parts
MONTGOMERY WARD & CO.
Ward's sets are easy to install

Send for your free copy

Ward's New Radio Catalogue

The 52 fully illustrated pages of this new catalogue are simply invaluable to everyone interested in Radio. And one copy is to be yours Free—merely for the asking!

It shows guaranteed Radio sets, one tube sets that give remarkable results, and sets of every variety up to Ward's new five-tube one-dial control. Think of tuning in one station after another by turning a single dial!

It shows guaranteed, tested parts, batteries, cabinets, contains a list of stations, a radio log for recording stations. It is a complete radio manual—sent entirely free!

Ward's is Headquarters for Radio

And best of all, the catalogue offers you everything new in Radio at a big saving in price.

At Ward's, everything for Radio is sold without the usual "Radio Profits." Thousands of pleased customers write us of their constant delight with Ward's Radio products.

Our 53 year old Policy

For 53 years we have sold our quality merchandise under a Golden Rule Policy. You can rely absolutely upon the quality of everything shown in this Radio Catalogue.

Be sure and ask for Radio Catalogue No. 4-R.

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Montgomery Ward & Co
The Oldest Mail Order House is Today the Most Progressive
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We Can Help You Here—

TO develop an unusual device, a splendid tool or a useful appliance—only to be stumped by an intricate power problem—this is an every day experience with inventive geniuses. However well versed they may be along mechanical or technical lines, things electrical invariably get them into difficulties.

In the friendly desire to help these men solve their snaggy electrical problems—in the hope that our efforts will enable them to complete their work sooner, we invite them to call on our Engineering Department for assistance. The personnel of this department, skilled in harnessing fractional horsepower motors to "new fangled" machines and appliances, will undoubtedly find an answer to the riddle if it's humanly possible to do so.

Inventors—and manufacturers, too—are urged not to hesitate in utilizing the services of this corps of experts. They welcome problems that aren't easy—and best of all, there's no charge for their advice. Why not start them working for *you* today? Let them determine whether any member of our complete line of fractional h.p. units—ranging from 1/40 to 1/4 h.p.—will meet your special requirements. Just a short letter—and the trick is done.

WISCONSIN ELECTRIC COMPANY
48 Sixteenth Street Racine, Wisconsin

Dumore Fractional H.P. Motors

Type-SAX
1-25 h. p. motor with special base. Nickel plated. Operates on A. C. or D. C.
Type-A—Stripped
1-25 h. p. Cast iron frame. Enamel finish. Babbitt bearings, wick oil[illegible]. Operates on A. C. or D. C.
Type-D
1-8 h. p. Cast iron frame. Enamel finish. Plain bearings, grease cups. Operates on A. C. or D. C.
No. 3GM—Stripped
1-4 h. p. Aluminum frame. Enamel finish. Norma bearings, ventilated. Operates on A. C. or D. C.

The telephone door

More people enter our homes and offices by telephone than in person. Through the telephone door, traveling by wire, comes a stream of people from the outside world on social and business missions. Important agreements or appointments are made, yet the callers remain but a few seconds or minutes and with a "good-bye" are gone. We go out through our telephone doors constantly to ask or give information, buy or sell things, make personal calls and on dozens of other errands.

None of the relations of life is more dependent upon co-operation and mutual consideration than these daily millions of telephone journeys. It is the telephone company's part to furnish the means of calling and to place courteous and intelligent employees at the service of the public. Good service is then assured when there is a full measure of co-operation between users.

Only by mutual care and consideration can everyone enjoy the full pleasures and benefits of calling. Telephone courtesy is for the good of all who use the telephone door.

AMERICAN TELEPHONE AND TELEGRAPH COMPANY
AND ASSOCIATED COMPANIES
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THE LARGEST AND FINEST IN
SAINT LOUIS
Opposite Forest Park. 12 minutes from Union Station. Within 5 minutes of two leading golf courses.
The centre of fashionable social life. Inviting Roof Garden with music and dancing. 200 car garage in connection.
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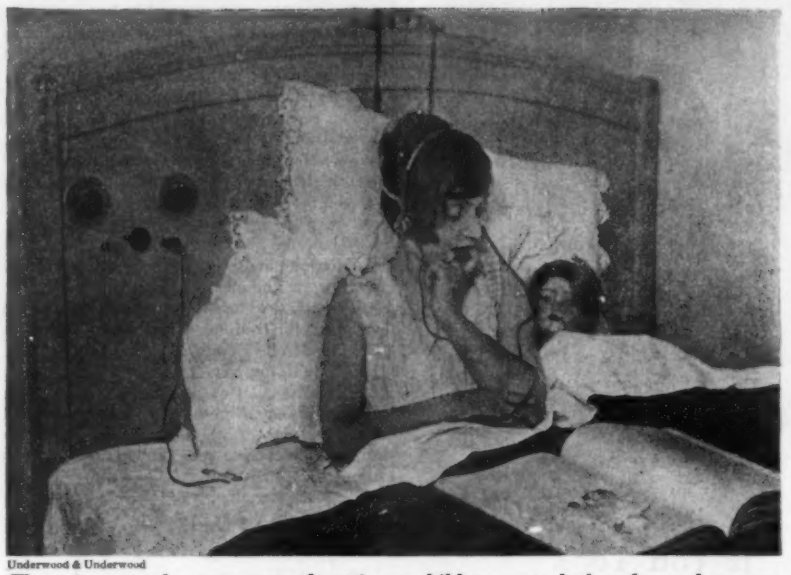


Underwood & Underwood

There is more than one way of getting a child to go to bed early; and a very pleasant way is to lure him or her by radio! A New York radiotrician has equipped his little girl's bed with a complete radio set

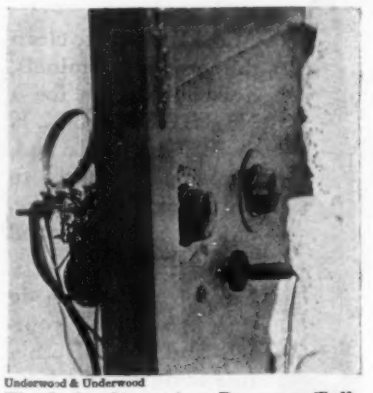
light, the resultant picture is seen in its natural color.

"With this process well known, it is obvious that three such negatives transmitted by radio could be colored and combined to make a radio picture. Of course, the picture is not sent in color, and I hesitate to claim for such a feat more than that the resultant picture proves the excellence of the synchronism of the machines employed in the transmission of the three successive pictures, which after they are received are to be colored and combined into one.

"The scheme of radio vision is just a long camera with miles instead of inches between the plate and lens."

New British Station Nearing Completion

WORK on the Daventry, high-power station is proceeding rapidly. It is planned that this station will relay London concerts to America for rebroadcasting this winter. The masts are 500 feet high and each has a light on the top as a warning to airplanes. The towers are triangular and of lattice-work with a ladder running up inside. The aerials are "T" type, 600 feet long. The ground is formed by zinc plates covering a 100-foot radius. The power is rated at 25 kilowatts. The call will be 5XX and the wavelength 1,600 meters.



Underwood & Underwood

The bed-radio-set is a Bremmer Tully circuit with detector in one step, using two UV199 tubes with loudspeaker volume

Germany Building Super-Broadcaster

A NEW 100-kilowatt station is under construction at Herzogstand, Bavaria, which will enable crystal set owners to hear the programs throughout all Germany. This will be the most powerful broadcaster in the world. The second largest German broadcaster will be Koenigswusterhausen, rated at 50 kilowatts.

Underwood & Underwood

The latest in decorative radio sets is provided with frames for portraits of film star favorites (or other favorites) set into the panels of the instrument. The above shows Clara Horton, herself a film star, tuned in on a concert in Hollywood

When you visit Detroit make this hotel your home

Here at the Fort Shelby you'll *feel* at home—for hospitality is a distinguishing feature of this hotel. Excellent equipment, friendly service and congenial environment make the Fort Shelby prominent in pleasant recollections of many thousands who visit Detroit. Yet charges are moderate. This is the *one* Detroit hotel with Servidor Service, protecting your privacy and purse.

Rates per day, $2.50 and up; a pleasant room with private bath, $3.50. Fort Shelby Garage, near the hotel, provides unexcelled accommodations.

HOTEL
FORT SHELBY
Lafayette Blvd. at First St.
DETROIT

A quiet location, yet close to the busiest downtown corner

Seth E. Frymire, *Manager* — W. G. McKay, *Ass't. Sec'y.*

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TWO YEAR COURSES
Send for Circular of Information.
Entrance Examination Sept. 18. School Opens Sept. 23.

Patent For Sale
It will do away with the present Engines and Boilers, Shaft and Propeller. It will run faster and cheaper than it has ever done before. Apply to Thos. Shaw, No. 3568 Calumet Avenue, Victoria, British Columbia, Canada.

UNISOL
Reg. U. S. Pat. Off.
The longer UNISOL is used, the more it is liked and appreciated—FOR BOILER FEED WATER TREATMENT.
NOTE: Recommended for well water and all other boiler plants. ASSURED.
Pamphlet on request
UNISOL MFG. CO. -:- Jersey City, N. J.

LORRAINE HOTEL
Broad St. at Fairmount Avenue.
•PHILADELPHIA•
ROOMS $2.00 UP. EUROPEAN PLAN.
• WRITE FOR BOOKLET •

There are about 1,000,000 licensed receiving sets in Germany and, it is estimated, about 1,500,000 "black" sets—those not licensed. The owner of a set is required to pay a tax of two marks a month and the collection is made by the postman. He is also authorized to report any sets operated without a license. It is expected that the license fee will be reduced to one mark a month as soon as the licenses total 1,500,000. The income is divided into two parts, two-fifths being retained by the post office and three-fifths by the broadcasting companies. There are other sources of income derived from advertising over the air.

Every artist who entertains before the German microphones is paid and this makes it possible to have the best artists broadcast, including the famous opera stars, the Berlin philharmonic orchestra and professors of the leading universities. Educational courses are a feature in the German ether. There is a variety of lectures on arts and sciences and at scheduled time each day different hours are devoted to languages.

Wavelengths of the German stations are definitely fixed by the government between 200 and 700 meters, but this may be extended, because the new super-stations will probably work on waves over 1,000 meters in length. German listeners have little complaint about interference, because it is a simple matter to arrange the twenty stations between 200 and 700 meters, compared to 570 transmitters in the United States vibrating the ether from 220 to 550 meters.

At the present time Germany has a news service on the higher wavelengths which serves from 500 to 800 papers, throughout the country. An owner of an ordinary broadcast receiver is forbidden to tune-in the news, because it might affect the circulation of the newspapers. At the same time the papers would not be purchasing a news service of much value if it became common property the moment it went on the air.

A large volume of advertising is radiated by the broadcasters, including men's clothing, furniture, women's wear and phonographs. It is reported that the advertisers are well pleased with the results, and that the expense is amply justified.

The cheapest radio receivers in Germany cost approximately ten dollars and the price runs up to $150 and more. Germany is exporting radio apparatus but not importing.

Court Decision on Antennae

THE German courts contend that if a radio antenna does not constitute a public danger, landlords cannot oppose the installation of the wires over buildings they own.

Dutch Firemen Have Radio-Equipped Truck

THE fire department of Amsterdam, Holland, has a motor truck equipped with a radio receiver and transmitter. When the fire alarm sounds the truck is taken to the scene to maintain communication with fire headquarters, which has complete radio equipment.

Press Service for Ships

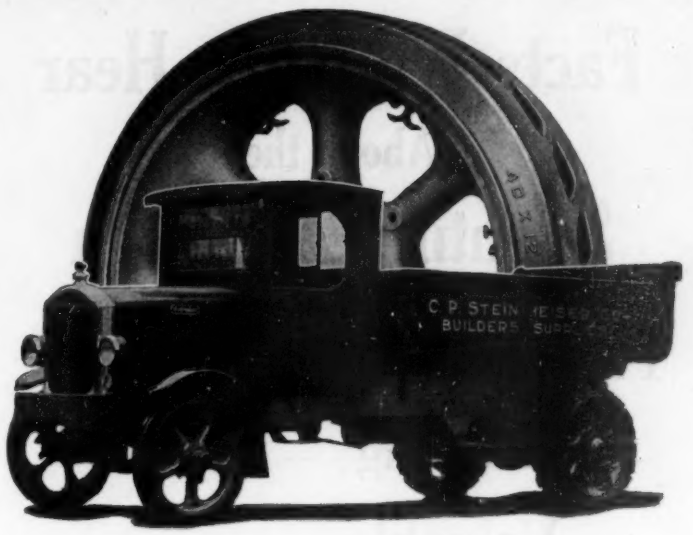
A NIGHTLY press service has been started by the Independent Wireless Telegraph Company from its East Moriches station, on Long Island. The service is free to all ships coming under the company's radio operation and control. The news items are broadcast every morning at 2:30 o'clock.

The dispatches contain a summary of the last-minute news from all parts of the world, and stock market quotations. Broadcasting is done on 2,478 meters.

Amateurs to Experiment With Pictures by Radio

THE Department of Commerce has authorized amateurs to experiment with the transmission and reception of photographs by radio. All wavelengths assigned to amateurs may be used for the tests. No change in license is required.

STRENGTH—LIGHT WEIGHT—DURABILITY



Gotfredson *uses* DAYTONS

Pleasing appearance is a valuable asset. Rugged power in motion has always claimed the world's admiration—the locomotive thundering over the rails—the dreadnought plunging thru heavy seas and the modern giant motor truck rushing silently on rubber-clad steel wheels over the roads.

The rugged attractiveness of the Gotfredson Truck is enhanced by the graceful, arched lines of its Dayton Steel Wheels.

Above we have a picture of power added to power—endurance added to endurance—quality added to quality—in the Gotfredson Truck and its Dayton Steel Wheels. For more and better truck service specify Daytons on your next order.

The Dayton Steel Foundry Co.
Dayton, Ohio.

Dayton
Steel Truck Wheels

TIRE ECONOMY—ACCESSIBILITY—APPEARANCE

SAVE TIME

Secure Better Illustrations USE AN ALL METAL
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LEARN WATCHWORK JEWELRY WORK AND ENGRAVING
A fine trade commanding a good salary and your services always in demand or you can start in business for yourself. At

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The greatest school for watchmakers in the world. Address Horological Dept. H, Bradley Polytechnic Inst., Peoria, Ill., for our latest catalogue.

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W. OTTWAY & CO., Ltd.
ESTABLISHED 1640
Stalking and Spotting Telescopes

Price $25.00
Post Free

This Telescope has been specially designed for stalking and signalling and would be found of very great use on outdoor Rifle Ranges, shot holes from the .22 Bore Rifles being easily determined at 100 yards. The Body Tubes and Mounts are of Brass Bronzed Black. The Body is covered in brown Calf with Caps and Slings.

Diameter of O. G.	Closed	Open	Magnification
1⅝	10½"	30½	25

If fitted with Panoratic Draw giving a variable power of 25 to 35, $3.65 Extra.

Illustrated Leaflet of Telescopes, etc., post free.
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Interesting

Valuable

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Useful

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Thorough

The Scientific American always has maintained and will maintain a journal worthy of its readers' expectations. If you are now subscribing, this coupon can readily be used for a friend or associate interested in joining the Scientific American family.

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Gentlemen:—Please send me the Scientific American for 3 months for $1, or 12 months for $4, for which I enclose remittance

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The Book Department

Below are given by subjects, some of the standard and recent books that can be recommended for clearness of treatment and understandability. FULL DESCRIPTIONS WILL BE FURNISHED ON REQUEST.

Industrial Processes

The Canning of Fruits and Vegetables by Zavalla..... $2.65
German Varnish-making by Bottler-Sabin..... 3.90
House Painting, Glazing, Paper-hanging and White-washing by Sabin..... 1.65
The Industrial and Artistic Technology of Paint and Varnish by Sabin..... 4.20
Red-lead and How to Use it in Paint by Sabin..... 2.15
White-lead. Its Use in Paint by Sabin..... 1.40
Modern Pigments and Their Vehicles by Maire..... 2.15
Manual for the Essence Industry by Walter..... 4.20
The Essentials of Printing by Henry..... 1.40
Printing for School and Shop by Henry..... 1.65
Steam Economy in the Sugar Factory by Abraham-Bayle..... 1.65
Beet-sugar Manufacture by Claassen-Hall-Rolfe..... 3.65
Technical Calculations for Sugar Works by Mittlestaedt-Bourbakis..... 1.65
Handbook for Cane-sugar Manufacturers and Their Chemists by Spencer..... 4.20
Manual de Fabricantes de Azúcar de Caña by Spencer-Cuadrado..... 5.20
Application of Dyestuffs to Textiles, Paper, Leather and Other Materials by Matthews..... 10.00
The Guide for Piece-dyeing by Reisig..... 25.00
The Science of Knitting by Tompkins..... 3.15

Landscape Gardening

Textbook of Landscape Gardening by Waugh..... 5.20
Landscape Gardening as Applied to Home Decoration by Maynard..... 2.65
Landscape Gardening by Kemp-Waugh..... 2.15
How to Lay Out Suburban Home Grounds by Kellaway..... 2.65
Shade-trees in Towns and Cities by Solotaroff..... 3.65
Field Book for Street-tree Mapping by Solotaroff..... 12.00

Mechanical Engineering

Mechanical Engineers' Handbook by Kent..... 6.00
The Engineers' Manual by Hudson-Lipka, et al..... 2.90
Ready Reference Tables by Hering..... 2.65
Belt Conveyors and Belt Elevators by Hetzel..... 5.20
Experimental Engineering and Manual for Testing by Carpenter-Diederichs..... 6.20
Gas Power by Hirshfield..... 1.90
The Modern Gas Engine and the Gas Producer by Levin..... 4.20
Gas Engine Theory and Design by Mehrtens..... 2.65
Carbureting and Combustion in Alcohol Engines by Sorel-Woodward-Preston..... 3.20
Mechanical Equipment of Buildings by Harding-Willard. Vol. I. Heating and Ventilation..... 6.20
Elements of Heating and Ventilation by Greene..... 3.65
Heating and Ventilating Buildings by Carpenter..... 3.65

Machine Design

Elements of Machine Design by Kimball-Barr..... 4.20
Machine Design Drawing Room Problems by Albert..... 3.15
Elements of Mechanism by Schwamb-Merrill-James..... 3.65
Kinematics and Kinetics of Machinery by Dent-Harper..... 3.65
Cams, Elementary and Advanced by Furman..... 3.15
Valves and Valve Gears by Furman:
Vol. I. Steam Engines and Steam Turbines..... 2.90
Vol. II. Gasoline, Gas and Oil Engines..... 2.40
Principles of Mechanism by James-Mackenzie..... 2.15
Velocity Diagrams by MacCord..... 1.50

Shop and Foundry Practice

Forge-practice and Heat Treatment of Steel by Bacon..... 2.65
Machine-shop Tool and Methods by Leonard..... 3.65
Machine Shop Practice by Kaup..... 1.90
Foundry Practice by Palmer..... 3.15
Oxy-acetylene Welding Manual by Campbell..... 1.65
Gear Cutting Machinery by Flanders..... 2.65
Handbook of Small Tools by Oberg..... 3.65
Plain and Ornamental Forging by Schwarzkopf..... 2.15
Press Working of Metals by Smith..... 3.15
Foundry Practice by Tate-Stone..... 2.40
Moulder's Text Book by West..... 4.20

All prices postpaid

Evolution

(Descriptions not available)

Scientific, Popular

From the Unconscious to the Conscious by Geley..... 3.15
The Riddle of the Universe by Haeckel..... 2.65
Wonders of Life by Haeckel..... 2.65
Mind in the Making by Robinson..... 2.65
Evolution and Animal Intelligence by Holmes..... 3.65
Essays on Evolution by Poulton..... 4.20
The Old Riddle and the Newest Answer by Gerard..... 2.15

Relation to Religion

Man and the Attainment of Immortality by Simpson..... 2.40
The Spiritual Interpretation of Nature by Simpson..... 2.40
Religion and Biology by Unwin..... 1.90
The Paths That Lead to God by Tillett..... 4.20
God is Writing a Book by Waldo..... 2.15
This Simian World by Day..... 1.65
I Believe in God and in Evolution by Keen..... 1.15
God or Gorilla by McCann..... 3.65
The Case Against Evolution by O'Toole..... 3.65

All prices postpaid

[All the above books are obtainable from the Scientific American Book Department, 233 Broadway, N. Y. C.]

TROPHIES

IN 1907 the Scientific American offered a trophy for the outstanding achievement of that year in aviation. It was won by Glenn H. Curtiss in his flight from Albany to Governor's Island, the first cross-country flight ever made and the most important achievement in the air up to that time.

Again the Scientific American offers a trophy. This time it is for the efficiency contest for light planes of not more than 20 horsepower in the National Air Races on October 10th. The event will be vastly different from Mr. Curtiss's effort of fifteen years ago. Then speed and endurance were sought, with utter recklessness in the power expended. Today, as a forerunner of truly commercial aircraft, the attention of designers must be directed to economy in flight. This the "air flivver" race will do.

It is a race that will bring out the young airplane engineer, rich in ideas but slender in purse.

STUNTING

THE day-by-day announcement of airplane fatalities is a very sad and disturbing record. There are altogether too many of these disasters. They are not so much the fault of the machine as of the man. Statistics prove this. That these fatalities are unnecessary and preventable is proved by the marvellous record of efficiency of 92 percent achieved by the transcontinental Air Mail Service. Why, then, do these daily disasters occur? They are due partly to the fact that men are flying airplanes who have not the necessary physical makeup or training, and partly they are due to stunting.

We are inclined to believe that this unnecessary and foolish practice is answerable for a large part of the disasters. The remedy must be sought in Federal legislation, which the reputable airplane interests of the country have been trying to secure for many years past. Why Congress refuses to move in this matter is beyond our understanding.

PREJUDICE

MUCH of the prejudice against the railroads is due to ignorance. The people who are clamoring for nationalization of the railroads are, generally speaking, those who know next to nothing about the origin, ownership and internal working of these great properties.

The United States has built up a stupendous system, with 260,000 miles of railroad. Who built it? The capitalists? They did not. The billions of dollars that have been poured into railroad construction and equipment came out of the pockets of private individuals. They were contributed by Tom, Dick and Harry; and today railroad securities are probably more widely scattered and held by a greater diversity of people, from presidents to trainmen, from banker to storekeeper, than those of any other great industrial or commercial institution. Do not be misled by the shibboleths and parrot cries of the professional agitator.

In This Issue

A Piece of Lead. Presto! It's Mercury—Perhaps

If we could knock one electron out of the lead atom we ought to have mercury. Can science do this trick? Two eminent Dutch scientists have been trying, and if they succeed, they and others who are trying like experiments, will change theories into facts. See page 230.

But What Does the Gland Authority Say?

Newspaper feature-writers and novelists have written extravagantly about the rejuvenating effects of gland grafting. Just what is the truth about it? There is one man who ought to know, if anyone does—Dr. Serge Voronoff, one of the recognized leaders in this field of surgery. In an exclusive interview he tells us just what he has accomplished and how he has accomplished it. Page 226.

A $65,000,000 Map

The man on the cover of this month's issue is only one of the Government's many engineers risking his life to make the "mother map" of the United States, a map which will show every hamlet, railroad, hill and stream in the country. In the article on page 221, Guy Elliott Mitchell of the U. S. Geological Survey, describes the most comprehensive map-making effort the world has ever known.

Fingerprinting the Innocent

For your own protection the prints of your fingers ought to be on record, declares Police Commissioner Enright of New York City. On page 224 he describes the system prevailing in Buenos Aires, where its most enthusiastic boosters are our own citizens who live there, and tells us why he wants us to adopt one like it.

Evolution Complete—On One Page

From the primaeval nebula of gas, untold trillions of years ago, to now—evolution—cosmic, then organic—has molded the course of the universe. Save out an extra hour for the evolution chart—and be sure to save the chart as a guide to your reading about evolution.

MORE THAN 150 PICTURES

Complete table of contents will be found on page 288.

For Next Month

Telescopes for the Average Purse

In the foothills of the Green Mountains lies one of the best known machine works in the country. A group of its workers have taken up astronomy. At a cost of less than $50, each has made a reflecting astronomical telescope capable of real scientific observation. Mr. Ingalls of our staff went to their unique observatory to write for the November issue the story of how they ride their hobby. Out October 20.

Dye—The New Antiseptic

What to do with a germ that may be killing you? Dye it, is the latest theory of the scientists. You'll enjoy reading of the remarkable experiments of Dr. Churchman of the Cornell Medical School in the use of aniline dyes in treating disease. As antiseptics they are believed by many to be better than iodine or bichloride of mercury.

What Accounts for Those Gray Hairs

The harrowing tale of the man whose hair turned snow white over night is unadulterated bunk, declares Dr. L. A. Hausman, one of our contributing editors, in an illuminating article on the cause of gray hair.

Other articles on Linking Mexico and California; Puncturing the Lie Behind Every Crime; Another Victory for Oil Equipment; Radio and Astronomy.

MORE THAN 150 PICTURES

¶ ***Each month sees a long stride forward in science and in industry. Don't get out of step with the procession. Read the Scientific American and march along with the leaders. Send a dollar for three issues and see how much you will enjoy it.***

PROFITEERS

SPEAKING of railroad finances, we notice in a recent issue of the *Railroad Review* a statement that a New York investigation disclosed the fact that for a box of apples, for which the New Yorker pays $5.09, the Oregon producer and packer receives $1.19. Here is a difference of nearly $4.00. Who got it? The railroads? No, indeed; for they received for the carriage of that box of apples only 78 cents. The balance of $3.12 was grabbed by certain people who got their hands upon that box of apples "between the freight cars at the New York terminal and the consumer in a New York flat." So, if you want to get after the profiteer, go for the middlemen.

CAUTION

OVER the way from the editor's country home is a railroad crossing—just such a one where you might picture an express train crashing into a motor car. One day we watched the stream of automobiles passing over. Out of fifty-seven motorists who crossed, thirty-one tooted their horns as they approached the tracks.

All of which goes to show there is more than one way of trying to play safe. It is a bit of evidence, moreover, tending to show that the average motorist does try to exercise caution. Further evidence lies in the flood of letters that deluge the editor's desk commenting upon the traffic articles by H. E. Slauson, our automotive editor. Most of them agree with his suggestions for making the highways safe. In fact, it would seem almost as though the only reckless drivers in the country are the ones who fail to read the Scientific American.

PHOTOGRAPHS

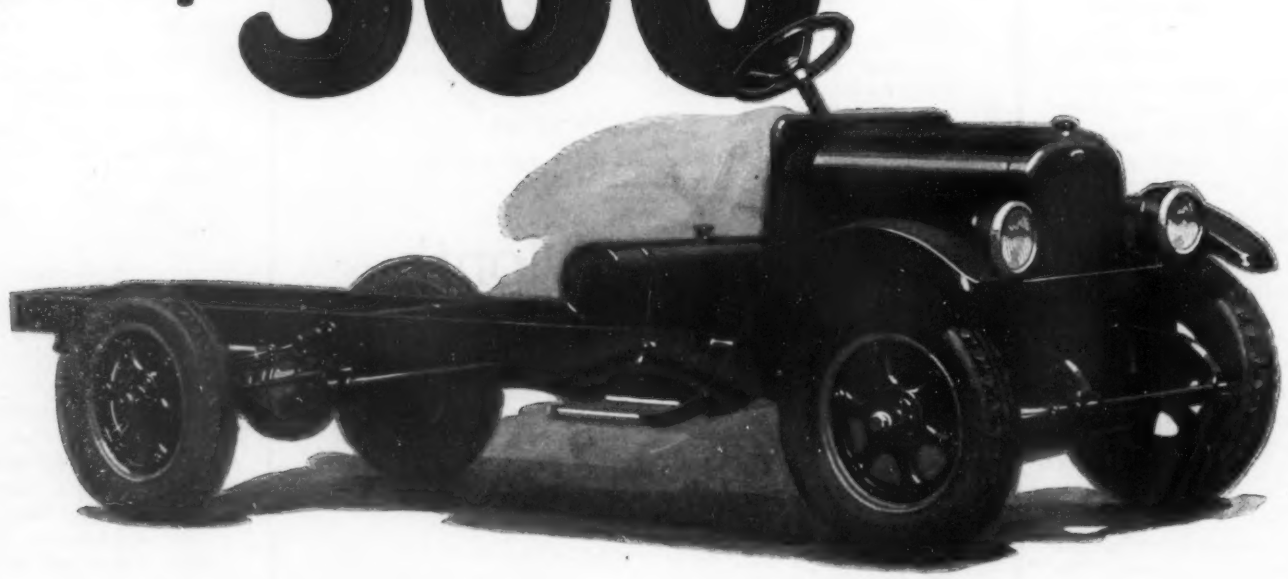
CONTRIBUTORS to the Scientific American should remember that photographs of large constructions often lose their impressiveness for want of some scale of measurement. The model-maker, working to scale, can produce so accurate a representation that it is impossible, from the photograph, to tell whether the thing shown is, let us say, a 400-ton locomotive or a 400-pound model. Put a man in the picture and the photograph speaks for itself.

MEMORIAM

JUST as the September issue of the Scientific American reached the reader, word was received that A. B. Skinner, the author of one of the most unusual articles in the number, "Grisly War Trophies," had been killed in an automobile accident in North Dakota. "Amos One-Road," his Indian assistant, was unhurt.

A brilliant anthropologist, Mr. Skinner held important positions in the American Museum of Natural History and later in the Museum of the American Indian, Heye Foundation. His passing is a distinct loss, not only to science but to humanity, for the welfare of the Red Man, whose traditions he knew and with whose ideas he sympathized, was close to his heart.

Another FEDERAL Knight Motored 1½-2 Ton Truck for $500 less



Knight engine—other big exclusive features—$500 less than the former 1½-2 ton Federal. This remarkable value is made possible by the assurance of tremendous volume from a pressing demand for a heavy duty Knight motored truck.

Thousands of Federal owners proclaim the Knight engine—the most economical and efficient they have ever used.

No carbon to clean or valves to grind. Fewer parts—more power—less wear. An engine you will never wear out.

Now, you can obtain the advantages of this new model at a price so low that you should investigate this truck before making any purchase of new equipment. Secure at no cost—a demonstration in your work!

FEDERAL MOTOR TRUCK COMPANY, DETROIT, MICHIGAN

LOWER COST per TON MILE